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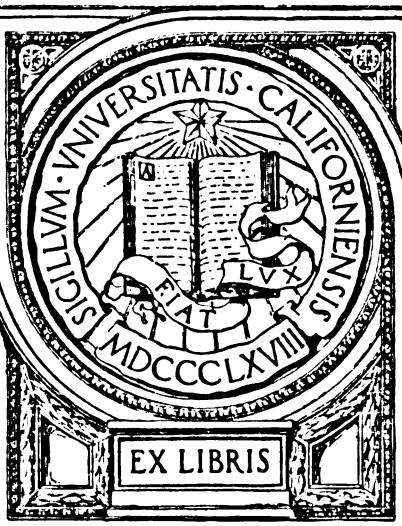

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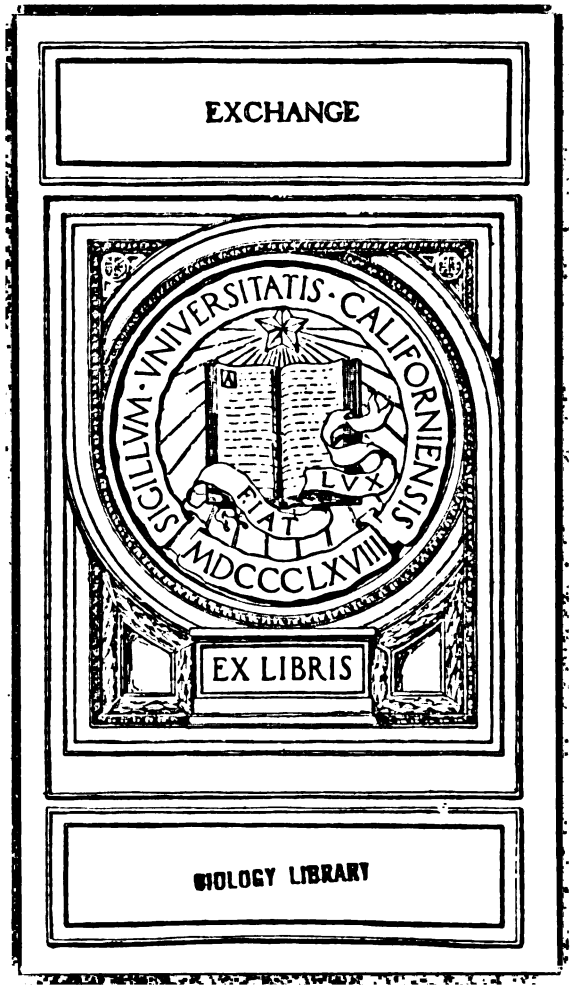

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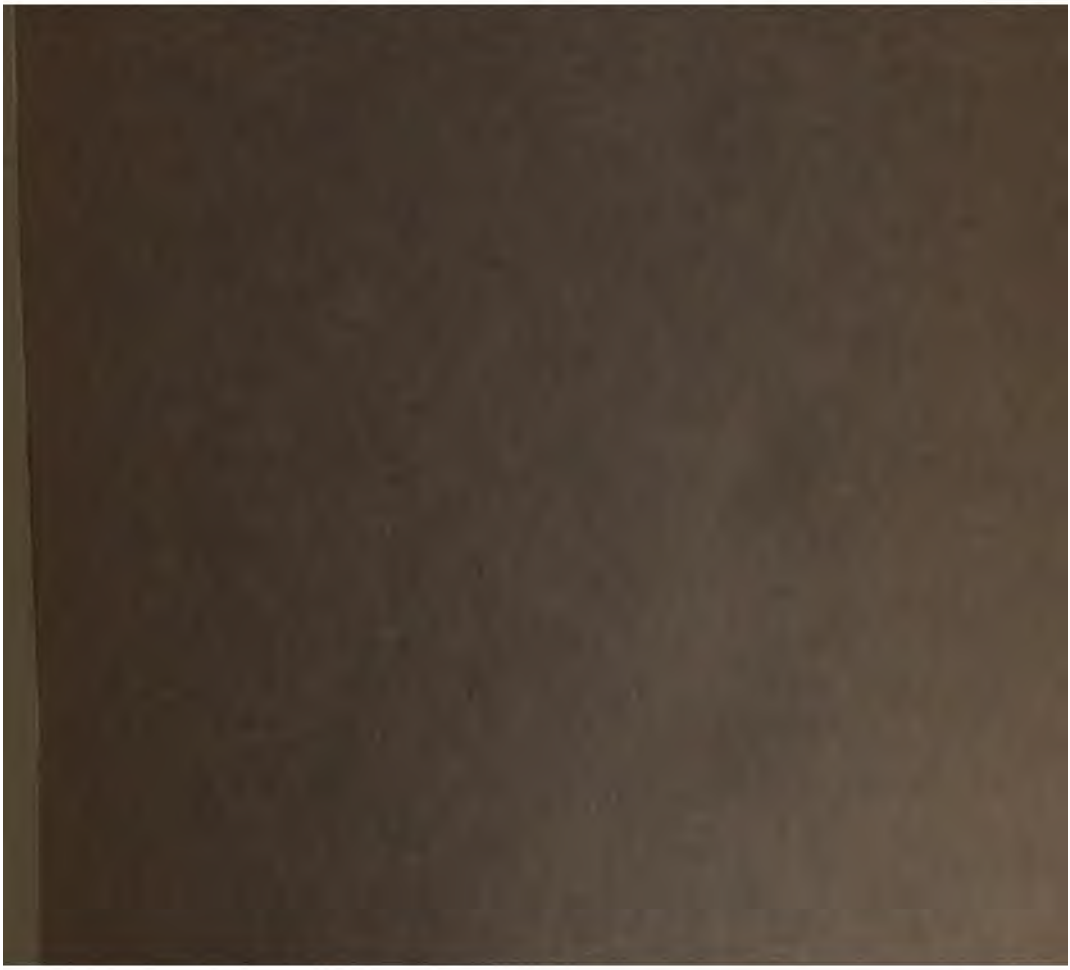

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By Gordon Floyd Ferris, Associate Professor of Zoölogy

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INTRODUCTION

This paper is the first of a proposed series, which when complete, it is hoped, will constitute what may justly be considered a monograph of the insect order Anoplura, or the sucking lice.

As a basis for this series of papers there is available what is without a doubt the largest and most comprehensive collection of these insects that is now in existence. This collection contains approximately three-fourths of the described species, among these being many that are known only from the extremely imperfect descriptions of the earlier authors. In addition to these, the collection includes a relatively very large number of new forms. With this material to begin with it is not unreasonable to hope that a nearly complete collection of the known species may finally become available for examination, and that this series of papers may thereby aspire to the dignity of a truly monographic study.

The sources of the material included in this collection are various, but by far the more significant portion has been obtained by the examination of the mammal skins in the collections of certain museums. It is the author's belief that in such collections there lies buried a nearly complete representation of the Anopluran fauna of the world, doubtless only a few of the species that occur on the larger mammals being lacking. It is perhaps not out of place to urge that the examination of such collections be undertaken whenever possible, nor, perhaps, is it out of place for the author to express a plea for additional material to the end that this monograph may be made as useful as possible.

Owing to the amount of new material, much of which belongs to types quite different from any that have been described, and to the necessary rearrangements that the examination of such a large percentage of the described forms will doubtless show to be advisable, all discussion of the group as a whole and all keys to the families and genera must of necessity be delayed until the final papers of the series.[1]

The final papers will also contain a complete host list, a bibliography, acknowledgments of the sources of material, and other matter of general interest.

The preliminary papers will, therefore, be of a purely descriptive

[1] Keys to the genera (with the exception of a few recently named) together with a bibliographic catalog of species and a list of hosts will be found in the following reference: Ferris, G. F., "A Catalog and Host List of the Anoplura," *Proceedings California Academy of Sciences*, Series 4, 6: 129–213, 1916.

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character. The order in which the various genera will be dealt with will be governed entirely by convenience, those genera of which the most complete representation of described species is available being considered first. By thus leaving until the end the genera that are poorly represented it is hoped that opportunity will be given for the accumulation of additional material in these groups.

The author is thoroughly convinced of the futility of written descriptions when dealing with objects of such complexity as are the members of this group. For this reason the emphasis throughout these papers will be placed upon the figures. The usual procedure is to regard the figures as merely explanatory of the text. In these papers the text will be regarded as being merely explanatory and confirmatory of the figures. The descriptions will consider only the more important characteristics of each species and these as briefly as is consistent with clarity.

All figures are from corrected camera lucida sketches made from individuals (the types whenever possible), that have been carefully prepared and in the majority of cases stained in order to permit more accurate observation. It is believed that the figures are accurate to a degree which is well within the limits of normal variation and the limits imposed by the processes through which the specimens pass in the course of their preparation for study. In all cases the figures have been drawn to the most convenient scale and are not to be used as a basis for judgment as to relative sizes. In all figures of the entire insect and of the genitalia (unless otherwise indicated) the left half of the figure represents the dorsal side, the right half the ventral side.

Keys to the species will not be given. It is the author's belief that the determination of species may be accomplished more quickly by reference to the name of the host and to the figures.

Finally, the benefit of criticism is desired that the standard of these papers may continuously be bettered and their usefulness increased.

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SYSTEMATIC TREATMENT

Genus **ENDERLEINELLUS** Fahrenholz.

1912. Fahrenholz, *Zool. Anz.*, 39: 56.
1912. Fahrenholz, 2., 3., u. 4, *Jahresb. des Niedersäch. zool. Ver. zu Hannover*, 52, 58.
1915. Kellogg and Ferris, Anoplura and Mall. N. Amer. Mammals, 40, Stanford University Publ.
1916. Ferris, Cat. and Host List of Anoplura, *Proc. Cal. Acad. Sci.* (4), 6: 148.
1916. Fahrenholz, *Archiv f. Naturgesc.*, Abt. A, 81: 29.

Anoplura without eyes; with five-segmented antennæ which are not sexually dimorphic; with the anterior and middle pairs of legs of equal size, small and weak and with weak claw, the posterior pair very stout and with broad, heavy claw; second sternite of the abdomen usually with a pair of small sclerites, each of which bears a backward-pointing, chitinous process; pleural plates present on a variable number of segments; each segment of the abdomen, both dorsally and ventrally, with at the most a single transverse row of spines or hairs; tergites and sternites of the abdomen without chitinized plates or with these very small; head more or less cylindrical, never with well-marked anterior-lateral and posterior-lateral angles; genitalia of the males of various types.

Hosts. Confined, as far as known, to members of the rodent family *Sciuridæ*.

Type of the Genus. *Enderleinellus nitzschi* Fahrenholz (= *Pediculus sphærocephalus* of Nitzsch, not of Olfers).

Synonymical List of Names Previously Used in the Genus

Note.—Synonyms are in italics.

kelloggi Ferris.
læviusculus (Grube).
Linognathoides læviusculus (Grube).
longiceps Kellogg and Ferris.
nitzschi Fahrenholz.
Pediculus sphærocephalus Nitzsch (not of Olfers).
Hæmatopinus sphærocephalus (Nitzsch).
Polyplax (?) *sphærocephalus* (Nitzsch).
Enderleinellus sphærocephalus (Nitzsch).
osborni Kellogg and Ferris.
Enderleinellus suturalis var. *osborni* Kellogg and Ferris.
Sphærocephalus (Nitzsch).
nitzschi Fahrenholz.

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suturalis (Osborn).

Hæmatopinus suturalis Osborn.

Polyplax (?) *suturalis* (Osborn).

Enderleinellus suturalis var. *occidentalis* Kellogg and Ferris.

suturalis var. *occidentalis* Kellogg and Ferris.

Enderleinellus suturalis (Osborn).

suturalis var. *osborni* Kellogg and Ferris.

Enderleinellus osborni Kellogg and Ferris.

tamiasis Fahrenholz.

uncinatus Ferris.

Microphthirus uncinatus (Ferris).

NOTES.—The affinities of this genus are at present extremely obscure. All the species (excepting only *E. euxeri* n. sp.) agree in the possession of a pair of small chitinized areas on the second sternite of the abdomen, each of which bears a backward-pointing process, a character that appears in no other group. The homologies of these structures are doubtful, but it is possible that they represent portions of the first pair of pleural plates. Some support to this view is lent by the fact that in *E. suturalis* these chitinized areas are almost continuous with the first pair of pleurites and by the fact that in one other genus, *Fahrenholzia,* the first pair of plates are divided, one-half lying on the dorsal side and the other half on the ventral side. No evidence is afforded by the developmental stages as these areas on the second sternite appear only at the last ecdysis.

The one species, *E. euxeri* n. sp., in which these areas are lacking is in other respects sufficiently like the other members of the genus to render unnecessary any attempt to separate it generically. I am, however, removing from this genus the species previously described by me as *E. uncinatus.* Although the affinities of this remarkable little species are clearly with *Enderleinellus* it is so peculiar that it well merits special recognition.

Fahrenholz has recently referred *Pediculus læviusculus* Grube to *Enderleinellus.* This species was described from *Citellus eversmanni.* I have at hand two species from this host, one an *Enderleinellus,* the other a *Linognathoides.* The original description of *P. læviusculus* is extremely brief and the figure crude, but there are certain points about both which leave no doubt that the species to which they refer is the *Linognathoides* and not the *Enderleinellus.*

The immature stages of but few species of this genus are at hand, and of these it is almost exclusively the penultimate stage that is represented. This stage differs from the adult chiefly in the absence of the paired sclerites on the second sternite and in a general reduction in the number of spines.

1. Enderleinellus nitzschi Fahrenholz.

FIGS. 1, 2.

1818. *Pediculus sphærocephalus* Nitzsch, *Germar's Mag.,* **3**: 305. (Not *Pediculus sphærocephalus* Olfers, 1816.)

1842. *Hæmatopinus sphærocephalus* (Nitzsch), Denny, "Mon. Anopl. Brit.," 36.

1864. *Pediculus sphærocephalus* Nitzsch, *Zeit. f. ges. Naturw.,* **23**: 27.

1874. *Hæmatopinus sphærocephalus* (Nitzsch), Giebel, "Insecta Epizoa," 35–6; pl. 1, f. 4.

1880. *Hæmatopinus sphærocephalus* (Nitzsch), Piaget, "Les Pediculines," 640–41.

1904. *Polyplax* (?) *sphærocephala* (Nitzsch), Enderlein, *Zool. Anz.,* **28**: 143.

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1908. *Polyplax* (?) *sphærocephala* (Nitzsch), Dalla Torre, Anoplura, 14, Gen. Ins.
1910. *Polyplax* (?) *sphærocephala* (Nitzsch), Mjöberg, *Arkiv för Zoologi*, **6**: 13, 159–160.
1912. *Enderleinellus sphærocephalus* (Nitzsch), Fahrenholz, *Zool. Anz.*, **39**: 56.
1912. *Enderleinellus spærocephalus* (Nitzsch), Fahrenholz, **2.**, **3.**, u. **4**, *Jahresb. des Nieder säch. zool. Ver. zu Hannover*, 52–3; tf. 22–3; pl. 2, f. 5–7.
1916. *Enderleinellus sphærocephalus* (Nitzsch), Ferris, *Psyche*, **23**: 107.
1916. *Enderleinellus nitzschi* Fahrenholz, *Archiv. f. Naturges.*, Abt. A, **81**: 29.

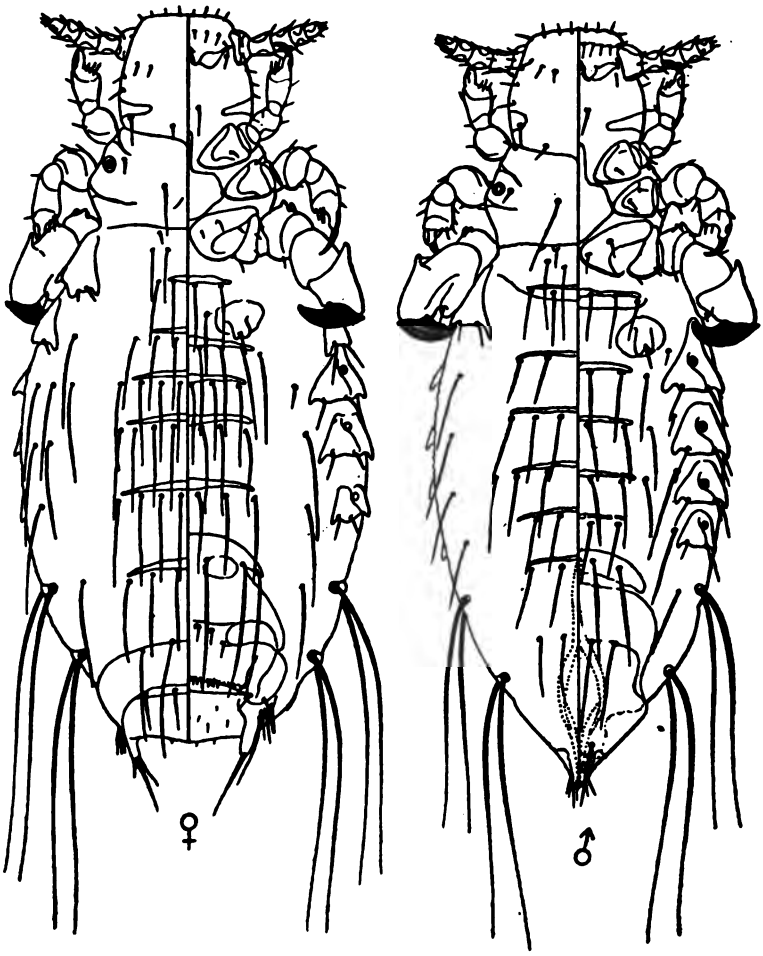

Fig. 1.—*Enderleinellus nitzschi* Fahrenholz.

HOST OF THE TYPE. *Sciurus vulgaris*, Europe.

MATERIAL EXAMINED. From *Sciurus vulgaris fuscoater*, Switzerland; *S. syriacus*, North Syria; *S. hudsonicus petulans*, Glacier Bay, Alas-

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ka; *S. hudsonicus vancouverensis,* Kuiu Ids., Alaska; *S. douglasi mollipillosus* and *S. douglasi albolimbatus,* California; *S. fremonti,* Colorado.

FEMALE (Fig. 1). *Length* 0.9 mm. *Head* but little longer than broad, the anterior margin broadly truncate, the lateral margins nearly parallel; antennæ set very close to the anterior margin; rostrum on the ventral side between the bases of the antennæ. *Thorax* somewhat shorter than the head; sternal plate (Fig. 2*B*) rather spatulate in form, having a narrow, handle-like portion which extends forward between the anterior coxæ; posterior femora with a pair of tooth-like processes on the anterior margin, posterior tibiæ with a similar process at the outer anterior angle.

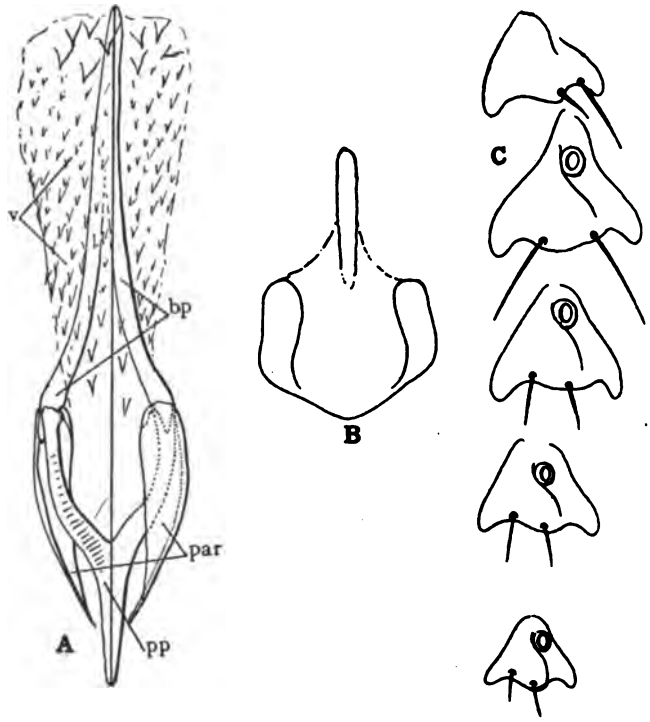

Fig. 2.—*Enderleinellus nitzschi* Fahrenholz; *A,* genitalia of male; *B,* sternal plate; *C,* pleural plates.

Abdomen elongate-oval, the apex truncate and produced into a lobe-like process at the angles. Pleurites (Fig. 2*C*) present on the second to sixth segments, all more or less triangular in shape, the posterior angles produced and with a pair of rather short spines on the posterior margin. Spiracles small, present on the last four pleurites. Ninth tergite for the most part occupied by a transverse sclerite which extends entirely across the segment; second to seventh tergites each with a narrow sclerite which

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occupies the median third or fourth. Spines all quite slender, arranged in median and sub-marginal series. In the median series there are four spines on the first and second segments, six to eight on the third to seventh segments and two on the eighth and ninth segments. In each submarginal series there is one on the third segment, three on the fourth, two on the fifth, and one on the sixth and seventh. Eighth and ninth segments each with a pair of long, slender setæ at each lateral margin. On the ventral side the arrangement is quite similar, except that the greater part of the seventh to ninth segments is occupied by the large genital plate. The lobe-like processes at the end of the abdomen each bear a single large spine and at their bases there is a cluster of smaller spines.

MALE (Fig. 1). *Length* 0.8 mm. In all respects closely resembling the female, except that the end of the abdomen is sharply pointed. Genital plate a broad sclerite occupying most of the seventh sternite and with its posterior lateral angles produced into a slender process which reaches the lateral margins at the posterior lateral angles of the eighth segment.

Genitalia (Fig. 2*A*) of a simple type. Basal plate[2] (*bp*) a slender rod which is expanded and deeply bifid at the posterior end. To the basal plate articulate the flattened parameres (*par*). Between the parameres is the pseudo-penis (*pp*), the arms of which appear likewise to articulate with the basal plate. The penis, the endomeres, and certain other parts usually associated with them appear to be lacking, or, it were probably more correct to say, unchitinized. The vesicula penis (*v*) is plainly evident by reason of the numerous teeth that it bears.

NOTES.—The description given above is based upon the specimens from *Sciurus vulgaris*, but those from the other hosts agree with these in all respects.

This species is a rather extreme member of the genus, the very short head, the presence of five pairs of pleural plates and the character of the genitalia of the male distinguishing it sharply from the nearest related form which is possibly to be found in *E. kelloggi* Ferris.

---

[2] The terminology of the parts of the male genitalia used herein is that used by Cummings (*Proc. Zool. Soc. London*, p. 257, 1916), except that the term "vesicula penis" is used in lieu of "preputial sac," the former term being that employed by Nuttall (Parasitology, 9: 301, 1916). The latter author has made a very careful study of the genitalia of *Pediculus humanus* Linnæus and has proposed a set of descriptive terms for the parts of the male genitalia of this species. Unfortunately the study was confined to this species alone and aids but little in homologizing the structures found in other species. In the absence of any careful comparative studies of numerous forms it becomes a difficult matter to interpret and homologize these structures. It should therefore be understood that in this paper the application of the various terms is purely tentative and is extremely subject to error.

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2. Enderleinellus malaysianus n. sp.

FIGS. 3, 4.

HOST OF THE TYPE. *Sciurus lucas*, St. Lukes Id., Mergui Archipelago, Malaysia. Holotype, a male.

SPECIMENS EXAMINED. From the type host; from *S. bentincani* Bentinck Id., Mergui Archipelago; *S. borneoensis*, Pulo Kanchut, Borne

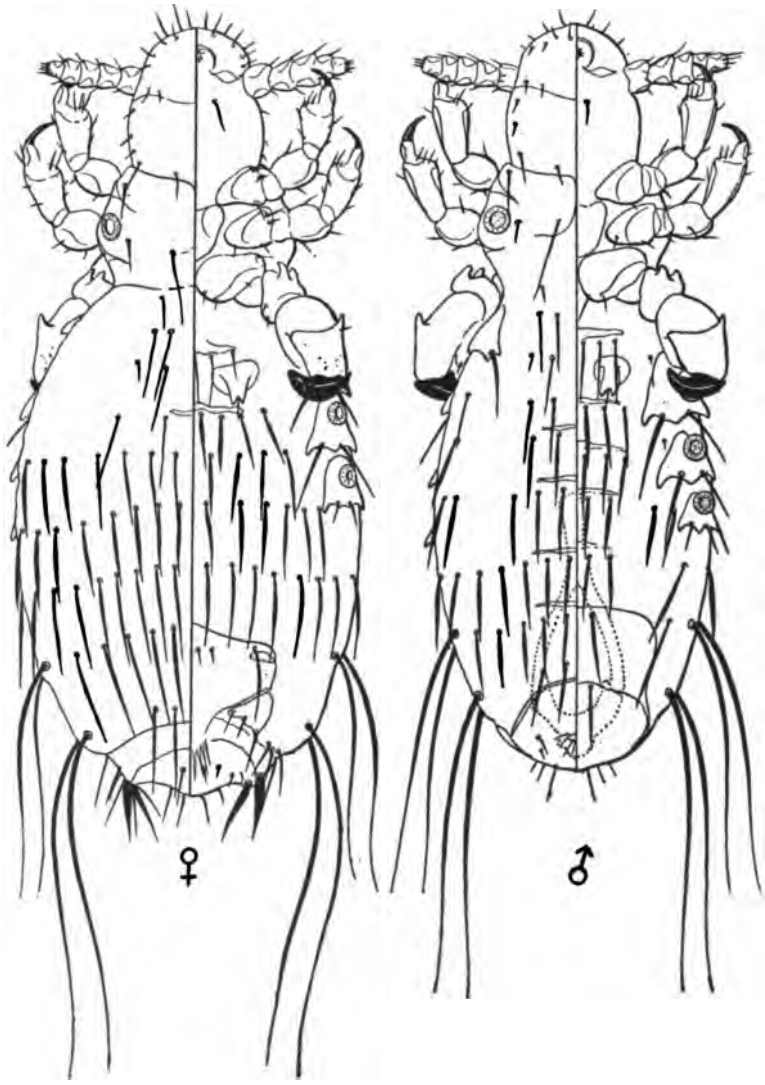

Fig. 3.—*Enderleinellus malaysianus* n. sp.

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S. davisoni, Trong, Lower Siam; *S. domelensis,* Domel Id., Mergui Archipelago; *S. lancavensis,* Pulo Teratau.

MALE (Fig. 3). *Length* 0.6 mm. *Head* somewhat longer than wide, the anterior margin broadly rounded, the lateral margins nearly parallel; antennæ well back from the anterior margin; rostrum on the ventral side, slightly anterior to the bases of the antennæ. *Thorax* about as long as the head; sternal plate (Fig. 4*B*) cordate, the lateral portions more heavily chitinized than the remainder.

Abdomen elongate-oval, the apex rounded. Pleurites (Fig. 4*C*) present on the second to fifth segments. Spiracles present on the last three pairs of pleurites, apparently lacking on the remaining segments,

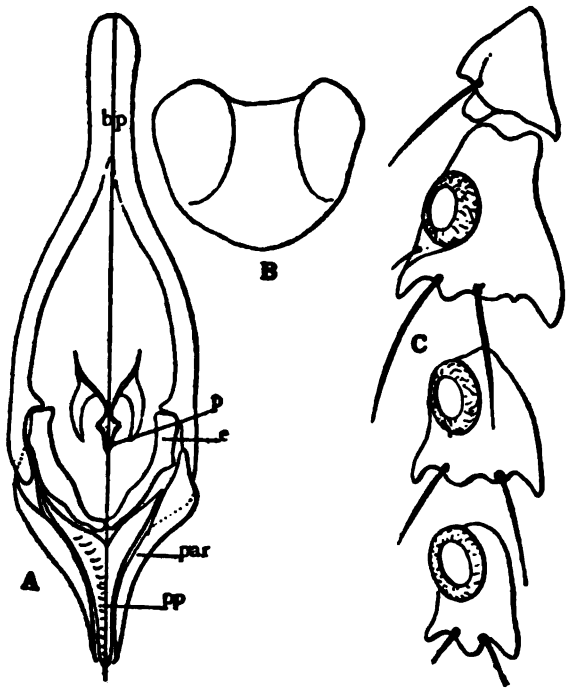

Fig. 4.—*Enderleinellus malaysianus* n. sp.: *A,* genitalia of male; *B,* sternal plate; *C,* pleural plates.

extraordinarily large and conspicuous. Fourth to seventh tergites each with a very narrow sclerite occupying the median fourth of the segment; ninth with a narrow sclerite extending across its entire width. Spines of the dorsum, moderately stout, arranged as follows: First to fourth segments each with a median group of four, fifth segment with median group of six, sixth and seventh with unbroken transverse row of ten to fourteen, third to fifth with one or two submarginal spines, seventh

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and eighth each with a pair of long setæ at each lateral margin. On the ventral side the arrangement is very nearly the same except that the sixth and seventh segments bear each a median group of two or four spines and a single submarginal spine instead of an unbroken transverse row. Genital plate occupying the greater part of the seventh sternite, quadrate in form, its posterior angles produced to the lateral margin of the ninth segment.

Genitalia (Fig. 4*A*). Basal plate (*bp*) composed of a single piece, which is cleft for more than half its length, the two arms having their tips widely separated. To the tips of the arms articulate the parameres (*par*), and between the parameres is the rather stout pseudo-penis (*pp*). Anterior to the pseudo-penis is an irregularly U-shaped piece (*e*), each arm of which articulates with a small sub-apical process on the corresponding arm of the basal plate. This piece is possibly the fused endomeres. Between the arms of the basal plate there is also a small, weakly chitinized structure which is probably the penis (*p*).

Female (Fig. 3). *Length* 0.7 mm. Differing from the male chiefly in the larger number of spines on the abdomen and in the absence of the small tergal and sternal sclerites. First to third tergites each with four small spines, fourth to sixth each with a continuous transverse row of fourteen to eighteen larger spines, seventh with ten, eighth with four. On the ventral side the arrangement is much the same except that the eighth sternite, which is for the most part occupied by the genital plate, bears but two spines. Extremity of the abdomen without lobe-like processes but with two or three large, flattened spines at the angles.

Notes.—While this species appears to be a member of the *nitzschi* group, it approaches in the character of the genitalia of the male most nearly *E. menetensis* n. sp. It is readily recognizable in either sex by the extraordinarily large spiracles and the presence of four pairs of pleural plates. The genitalia of the male are likewise quite distinctive.

3. Enderleinellus menetensis n. sp.

Figs. 5, 6.

Host of the Type. *Menetes berdmorei rufescens,* Koh Kut Id., Southeast Siam. Holotype, a male.

Specimens Examined. From the above host and locality only.

Male (Fig. 5). *Length* 0.5 mm. *Head* slightly longer than wide, the anterior margin broadly rounded, the lateral margins almost parallel. Antennæ set well back from the apex of the head. Rostrum on the ventral side slightly back from the anterior margin of the head. *Thorax* about as long as the head, the sternal plate (Fig. 6*B*) quadrate. Posterior femora

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each with a pair of tooth-like processes on the anterior margin and the posterior tarsi with a similar process at the outer anterior angle.

Abdomen broadly oval, the tip slightly pointed. Pleurites (Fig. 6C) present on the second to fourth segments, each with a pair of small spines

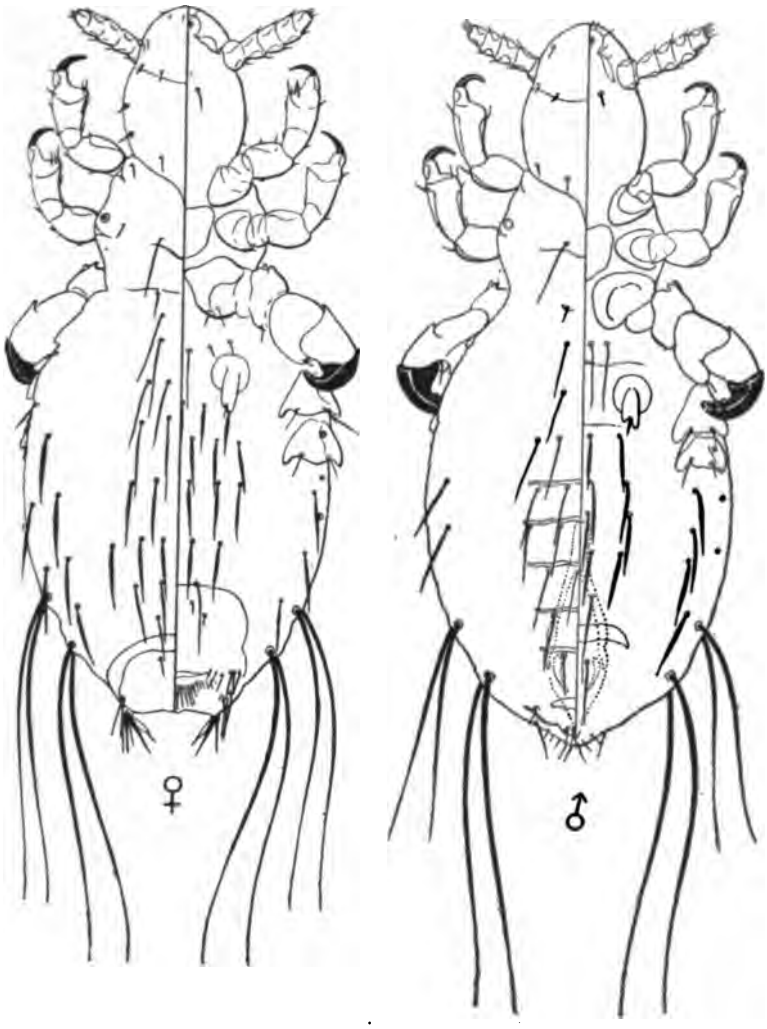

Fig. 5.—*Enderleinellus menetensis* n. sp.

on the posterior margin. Spiracles present on the last two pairs of pleural plates and on the fifth and sixth (and perhaps the seventh) segments, also; extremely small. Fourth to ninth tergites each with a very narrow sclerite occupying the median fourth of the segment. Spines all small

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and slender, few. The first, second, seventh, and eighth tergites each bear a median group of two, the remainder each bear a median group of four. Fourth and fifth segments each with a single submarginal spine. Seventh and eighth each with a pair of long setæ at each lateral margin. On the ventral side the arrangement of the spines is practically the same as on the dorsum, but all are conspicuously stouter. Sternites without chitinization except for the very small genital plate which consists merely of a small, transverse sclerite on the eighth segment.

Genitalia (Fig. 6*A*). Basal plate (*bp*) consisting of a single piece which is divided for more than half its length into two slender arms.

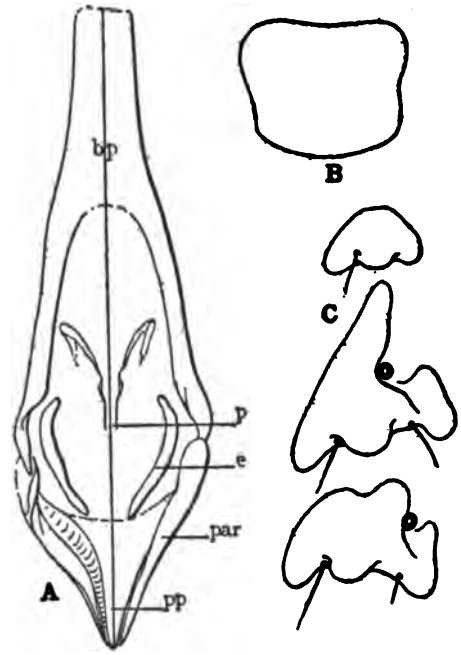

Fig. 6.—*Enderleinellus menetensis* n. sp.: *A*, genitalia of male; *B*, sternal plate; *C*, pleural plates.

The parameres (*par*) are rather slender and nearly straight, their tips converging. Between the parameres lies the stout pseudo-penis (*pp*). Anterior to the pseudo-penis are two small pieces which are perhaps the endomeres (*e*). Between the arms of the basal plate is a small, chitinized structure (*p*) which is perhaps the penis.

FEMALE (Fig. 5). *Length* 0.6 mm. In all essential respects closely resembling the male, but with the posterior end of the abdomen truncate, and with the tergites and sternites not chitinized, except for the genital

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plate and a narrow sclerite which extends across the tergum of the ninth segment. Apex of the abdomen with the angles slightly produced and bearing two or three flattened spines.

NOTES.—In the character of the genitalia this species is quite close to the preceding, but the presence of but three pairs of pleural plates, the very small spiracles and the paucity of spines will suffice to separate the two in both sexes. It is also probably quite close to the next species, *E. larisci* n. sp., from which it differs by the few spines in both sexes and in the genitalia of the male.

4. Enderleinellus larisci n. sp.

FIGS. 7, 8.

HOST OF THE TYPE. *Lariscus diversus*, Lanchut, southwest Borneo. Holotype, a male.

SPECIMENS EXAMINED. From the above host and locality only.

MALE (Fig. 7). *Length* 0.5 mm. *Head* slightly longer than wide, the anterior margin broadly rounded, the lateral margins nearly parallel. Antennæ set well toward the apex of the head. Rostrum on the ventral side, slightly back from the margin.

Thorax somewhat shorter than the head, the sternal plate consisting of two detached, oval pieces. Posterior femora with three tooth-like processes on the anterior margin and the posterior tarsi with a similar process at the outer anterior angle.

Abdomen broadly oval, sharply rounded at the tip. Pleural plates present on the second to fourth segments. Spiracles present on second to fifth segments, quite small. Tergites entirely unchitinized. Spines numerous, for the most part quite large and stout, arranged in median and sub-marginal series. In the median series there are two slender spines on the second and third segments, four on the fourth, six stout spines on the fifth, sixth and seventh and two on the eighth. The spines of the sub-marginal series are stouter than the others; there is a single spine on the third and seventh segments and four on the fifth to seventh. Seventh and eighth segments each with a pair of long setæ at each lateral margin. On the ventral side the spines are somewhat stouter. The arrangement is practically the same as on the dorsum except that there is no division into median and sub-marginal series. Sternites unchitinized except for the genital plate which consists of a small transverse sclerite occupying the median half of the seventh segment.

Genitalia (Fig. 8*A*). Basal plate (*bp*) quite stout, divided for about one third of its length into two sharply diverging arms. Parameres (*par*) flat and sharply pointed, their apices curving toward each other. Between the extreme tips of the parameres lies the very small pseudo-penis (*pp*).

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Also between the parameres are two elongated pieces (*e*), which are perhaps the endomeres. The penis (*p*) is quite small and usually lies well forward on the basal plate.

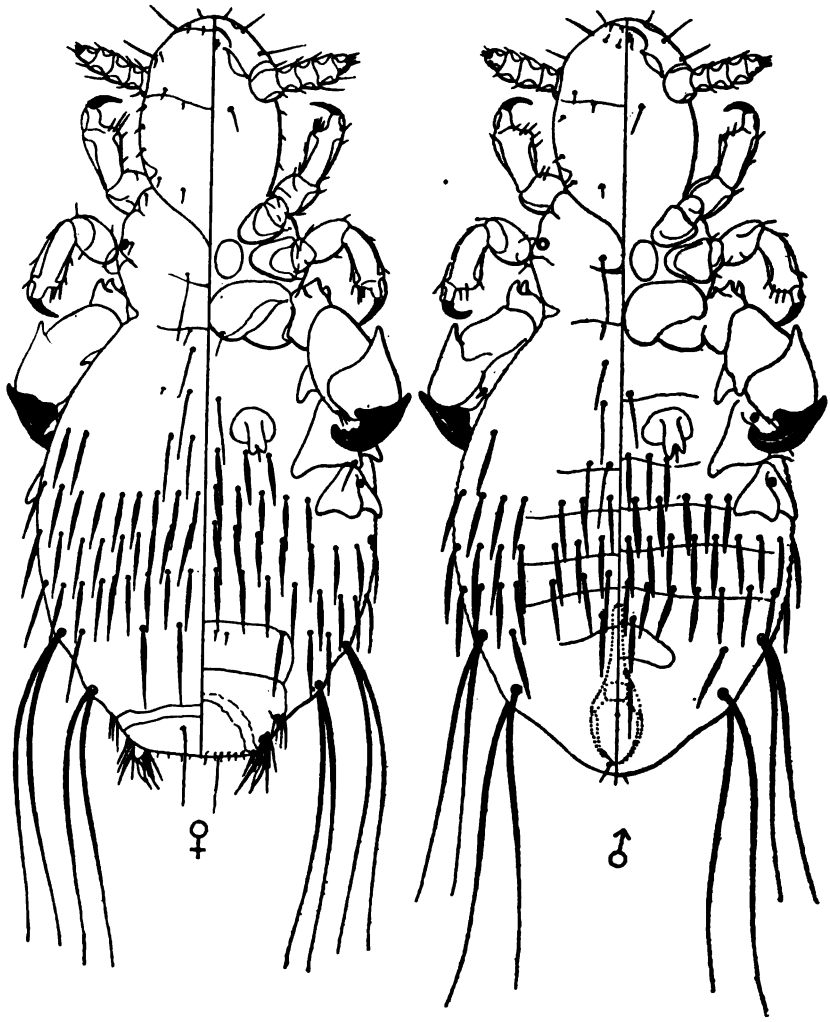

Fig. 7.—*Enderleinellus larisci* n. sp.

FEMALE (Fig. 7). *Length* 0.55 mm. In general very closely resembling the male, but with the abdomen slightly truncate at the tip, with the spines slightly more numerous. Ninth segment with a narrow, transverse sclerite extending across. Genital plate occupying the greater part of the eighth and ninth sternites. Apex of the abdomen with the lateral

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angles produced into small lobes, each of which bears two or three flattened, spine-like processes.

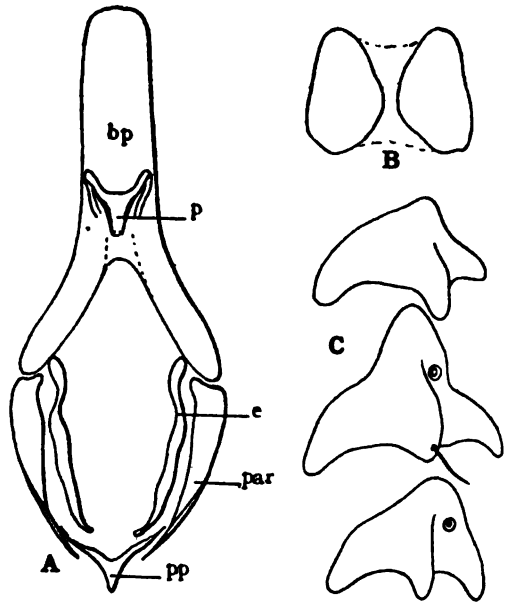

Fig. 8.—*Enderleinellus larisci* n. sp.: *A*, genitalia of male; *B*, sternal plate; *C*, pleural plates.

Notes.—This species probably is most closely related to the two preceding, *E. menetensis* and *E. malaysianus*, but is readily separable by the numerous stout spines, and the character of the genitalia.

5. Enderleinellus longiceps Kellogg and Ferris.

Figs. 9, 10.

1915. *Enderleinellus longiceps* Kellogg and Ferris, Anoplura and Mall. N. Amer. Mam., 44–6; pl. 2, f. 5; pl. 4, f. 12; pl. 6, f. 2. Stanford University Publ.
1916. *Enderleinellus longiceps* Kellogg and Ferris, Ferris, *Proc. Cal. Acad. Sci.* (4), 6: 148.
1916. *Enderleinellus longiceps* Kellogg and Ferris, Ferris, *Psyche*, 23: 105.

Host of the Type. "Gray squirrel," Lincoln, Neb. Both *Sciurus niger rufiventer* and *S. carolinensis* ssp. occur in this locality and both harbor this species. The typical host may be taken as the former.

Material Examined. The types and in addition the following: from *Sciurus niger rufiventer*, Waterloo, Ind., and Valentine, Neb.; *S. carolinensis*, Bayou St. Louis, Mississippi; *S. kaibabensis*, Kaibab National Forest, Arizona; *S. aberti ferreus*, Estes Park, Colorado; *S. apache*,

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Colonia Garcia, Chihuahua, Mexico; *S. oculatus,* State of Vera Cruz, Mexico; *S. nayaritensis,* Sierra Madre, Zacatecas, Mexico.

MALE (Fig. 9). *Length* 0.65 mm. *Head* considerably longer than wide, the anterior margin broadly rounded, the lateral margins almost

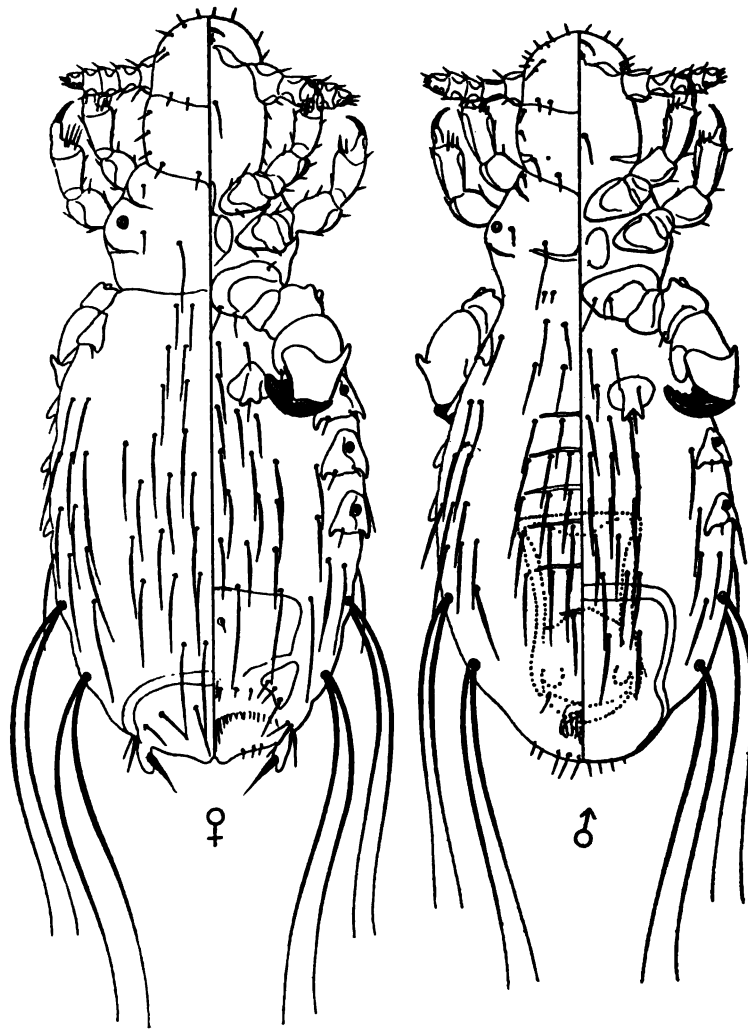

Fig. 9—*Enderleinellus longiceps* K. and F.

straight and practically parallel. Rostrum on the ventral side of the head, well back from the anterior margin. Antennæ set well toward the apex of the head.

Thorax about as long as the head, the sternal plate (Fig. 10*B*)

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spatulate in form, having a handle-like portion which extends forward between the anterior coxæ, the lateral portions of the plate more heavily chitinized than the remainder. Posterior femora with a pair of tooth-like processes on the anterior margin and a similar process at the outer anterior angle of the posterior tibiæ.

Abdomen elongate-oval, the apex rounded. Pleurites (Fig. 10) present on the second to fifth segments, all with the posterior angles somewhat produced and with a pair of small spines on the posterior margin. Spiracles present only in connection with the last three pairs of pleural

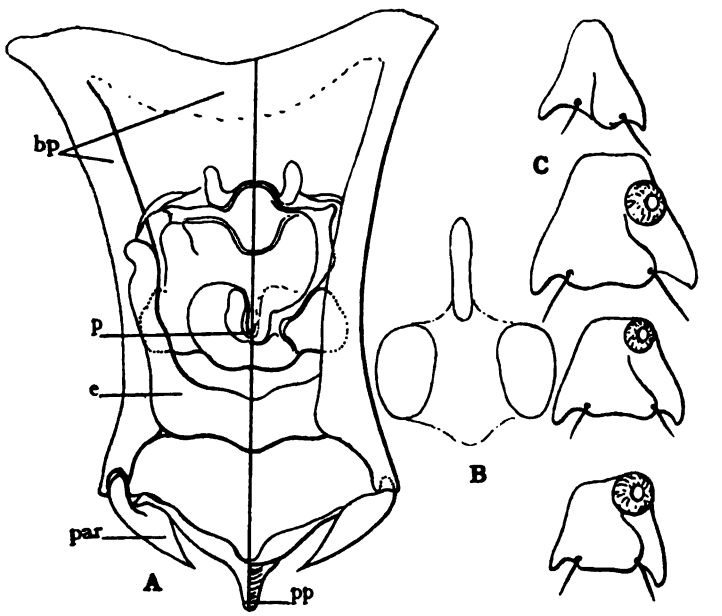

Fig. 10.—*Enderleinellus longiceps* K. and F.: *A*, genitalia of male; *B*, sternal plate; *C*, pleural plates.

plates, quite large and conspicuous. Tergites unchitinized except for a very narrow sclerite occupying the median third of each of the third to seventh segments. Spines quite numerous, varying from quite slender to moderately stout, arranged in median and submarginal series as follows: First, second, and third tergites with median group of four, fourth to seventh with median group of six. Second and seventh with a single submarginal spine, third and fourth with two, fifth and sixth with three. Seventh and eighth segments each with a pair of long, slender setæ at each lateral margin. On the ventral side the arrangement of the spines is practically as on the dorsum, but the spines are somewhat stouter. Sternites unchitinized except for the genital plate, which consists of a narrow

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sclerite occupying the median two-thirds of the seventh sternite and curved back to meet the lateral margin of the ninth segment.

Genitalia (Fig. 10*A*) extremely conspicuous, large, heavily chitinized and of a complex type. The basal plate (*bp*) consists of a pair of nearly parallel, widely separated rods, the anterior ends of which are connected by a less heavily chitinized cross piece. The tips of these rods are somewhat attenuated and to them attach the very small, flattened parameres (*par*) which point almost toward each other. Between the parameres is the pseudo-penis (*pp*), the arms of which are at an obtuse angle to each other. Between the arms of the basal plate lies a large and extraordinarily complex structure which is composed of the penis (*p*) and probably several other parts so fused as to have lost their identity. On the dorsal side of the basal plate and lying partially posterior to the penis is a U-shaped piece (*e*) which is possibly composed of the fused endomeres.

FEMALE (Fig. 9). *Length* 0.7 mm. In general closely resembling the male, but with none of the tergites chitinized except for a narrow sclerite extending across the ninth segment. Tip of the abdomen rounded or somewhat truncate, with the angles produced into small lobes, each of which bears a large, stout spine. Genital plate occupying the greater part of the eighth sternite.

NOTES.—This species may be taken as the type of a group of species from American species of *Sciurus*, this group including *E. kelloggi* Ferris and two other species that I am here describing as new. The group is distinguished by the peculiar character of the genitalia of the males, which, in their general characteristics, are similar in all the included species but differ in certain details. The females of this group are scarcely separable.

6. Enderleinellus kelloggi Ferris.

Fig. 11.

1916. *Enderleinellus kelloggi* Ferris, Cat. and Host List Anopl., *Proc. Cal. Acad. Sci.* (4), **6**: 148. (Without description.)

1916. *Enderleinellus kelloggi* Ferris, Ferris, *Psyche*, **23**: 105.

HOST OF THE TYPE. *Sciurus griseus nigripes*, Stanford University, California.

MATERIAL EXAMINED. The types and material from the following hosts: *Sciurus griseus griseus*, Pleasant Valley, Mariposa Co., Cal.; *S. goldmani*, Huehuetan, Chiapas, Mexico; *S. boothiæ*, San Pedro Sula, Honduras; *S. melania*, Boqueron, Colombia. Specimens from *Microsciurus mimilus*, Colombia, are tentatively referred to this species.

MALE. Differing from the male of *E. longiceps* only in the character of the genitalia.

Genitalia (Fig. 11*A*) in general resembling the genitalia of *E. longi-*

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ceps but with the rods of the basal plate more slender and much closer together, the parameres (*par*) larger and not pointing toward each other, the pseudo-penis relatively larger and with its arms meeting at a much more acute angle, the U-shaped endomeral piece (*e*) longer, the struc-

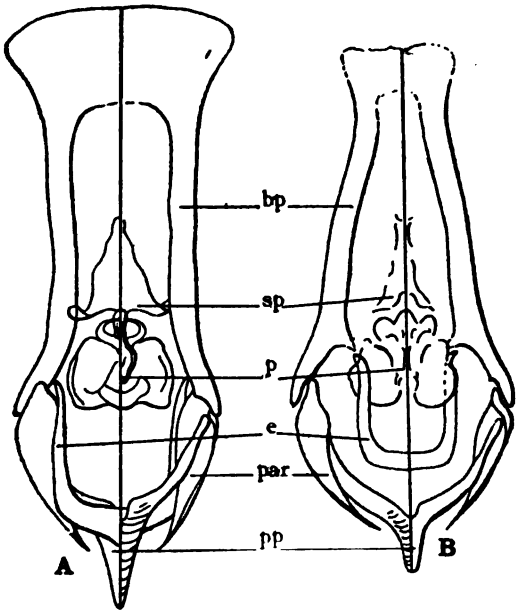

Fig. 11.—*Enderleinellus kelloggi* Ferris: *A*, genitalia of male, from paratype specimen; *B*, genitalia of male, from specimen from *Sciurus boothiae*.

tures surrounding and including the penis (*p*) very much smaller, and anterior to the penis a weakly chitinized structure (*sp*) which is perhaps the statumen penis of Nuttall.

FEMALE. Not recognizably different from the female of *E. longiceps*.

NOTES.—The specimens from *Sciurus boothiæ* differ from typical *E. kelloggi* somewhat in the character of the genitalia (Fig. 11*B*). The arms of the basal plate (*bp*) diverge somewhat instead of being nearly parallel, the penis and its surrounding structures are more weakly developed and the U-shaped endomeral piece (*e*) is smaller and very weakly chitinized. However, the specimens from *S. goldmani* stand directly between these two forms, as do those from *S. melania*. It is possible that further collecting may indicate the desirability of a separation.

The specimens from *Microsciurus mimulus* are referred to *E. kelloggi* only provisionally. The genitalia are of the type seen in the specimens from *Sciurus boothiæ*, the pleural plates seem to be somewhat larger, the genital plate of the male is larger and the tergal sclerites in the male are likewise noticeably larger. The material at hand, however, is not satisfactory and the specimens may be referred to *kelloggi* for the present.

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7. Enderleinellus extremus n. sp.

FIG. 12.

HOST OF THE TYPE. *Sciurus socialis,* Nenton, Guatemala.

SPECIMENS EXAMINED. From the type host and the following: *Sciurus aureogaster,* Papantla, Vera Cruz, Mexico; *S. aureogaster hypopyrrhus,* Quichicon, Oaxaca, Mexico; *S. deppei,* Teapa, Tabasco, Mexico; *S. griseoflavus chiapensis,* San Cristobal, Chiapas, Mexico; *S. negligens,* Alta Mira, Tamaulipas, Mexico; *S. nelsoni,* Huitzilac, Morelos, Mexico;

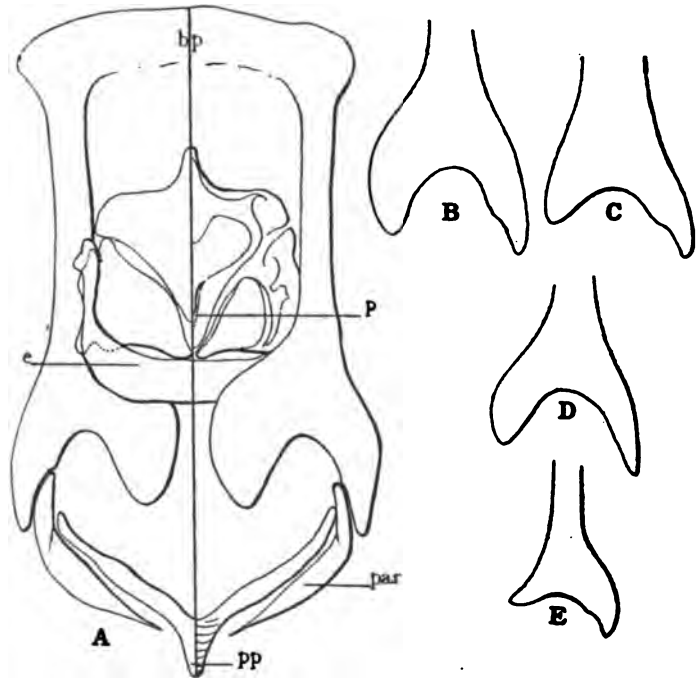

Fig. 12.—*Enderleinellus extremus* n. sp.: *A,* genitalia of male, holotype; *B,* end of arm of basal plate from specimen from *Sciurus nelsoni; C,* same, specimen from *S. arizonensis; D,* same, specimen from *S. truei; E,* same, specimen from *S. nesaeus.*

S. poliopus, Cerro San Felipe, Oaxaca, Mexico. In addition to the above I refer tentatively to this species specimens from the following: *Sciurus æstuans hoffmani,* Santa Clara, Costa Rica; *S. colliæ,* Santiago, Tepic, Mexico; *S. nesæus,* Margarita Id., Venezuela; *S. arizonensis huachucæ,* Huachuca Mts., Arizona.

MALE. Differing from *E. longiceps* in the character of the genitalia, the posterior ends of the arms of the basal plate being much expanded and deeply bi-lobed.

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Genitalia (Fig. 12*A*). In general as in *E. longiceps* but with the ends of the arms of the basal plate much expanded and deeply bi-lobed, the mesal lobe broader and more rounded than the outer. To the mesal face of the outer lobes articulate the small parameres (*par*), which are curved toward each other. Between the parameres is the small pseudo-penis (*pp*) with its arms set at an obtuse angle to each other. The penis (*p*) with its complex of surrounding structures is essentially as in *E. longiceps,* but the U-shaped endomeral piece (*e*) is perhaps somewhat shorter and broader.

FEMALE. Not distinguishable from the female of *E. longiceps.*

NOTES.—The type and the specimens which I refer definitely to this species agree quite closely in all respects and it seems that these may justly be separated from *E. longiceps.* The forms from *Sciurus æstuans, S. arizonensis, S. colliæ, S. nesæus* and *S. truei,* however, present a difficult problem, forming, as they do, a series between these two species. In the specimens from *S. nelsoni* the lobes of the arms of the basal plate (Fig. 12*B*) are slightly smaller than in typical *E. extremus,* but scarcely enough so as to arouse any doubt that these specimens should be referred to *extremus.* In the specimens from *S. æstuans, S. colliæ,* and *S. truei* these lobes are somewhat smaller (Fig. 12*D*). In those from *S. arizonensis* (Fig. 12*C*) the inner lobe is shorter and blunter, while in those from *S. nesæus* (Fig. 12*E*) it is little more than a spur, approaching the condition found in *E. longiceps.*

For the present I refer these forms in which the inner lobe is at all developed to *E. extremus.* It must be confessed that this procedure is unsatisfying—but it is probably less so than to name a species or a "variety" for each of these gradations. It would indeed be most interesting to examine specimens from all the American squirrels. Were this possible these forms might be disposed of in some better fashion.

8. Enderleinellus venezuelæ n. sp.

FIG. 13.

HOST OF THE TYPE. *Sciurus griseogena,* Macuto, Venezuela. Holotype, a male.

SPECIMENS EXAMINED. From the type host and the following: *Sciurus meridensis,* Montes del Escorial, Merida, Venezuela; *S. versicolor venuliæ,* Rio Aurare, Venezuela.

MALE. Of the general type of *E. longiceps,* differing essentially only in the character of the genitalia, these most nearly resembling the genitalia of *E. extremus.*

Genitalia (Fig. 13*A*). Basal plate (*bp*) with the ends of the arms expanded and deeply bi-lobed, the lobes nearly equal. To the mesal face of the outer lobe articulate the short, flat parameres, which are curved toward each other. Between the parameres is the pseudo-penis (*pp*) the tip of which is quite short and the arms set at an obtuse angle to each

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other. The U-shaped endomeral piece (*e*) is broad and short. The penis (*p*) and its surrounding structures are of a characteristic shape, the whole structure being triangular or of a trefoil shape with the apex directed forward, in contrast to the more or less quadrate form seen in other species.

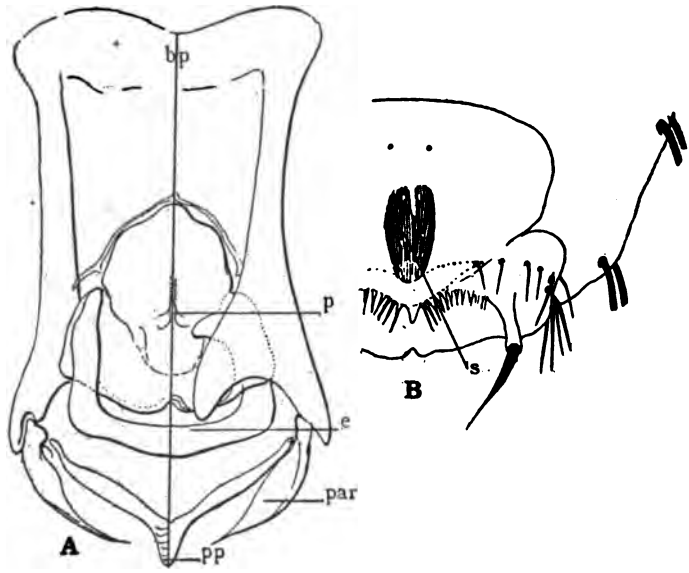

Fig. 13.—*Enderleinellus venezuelae* n. sp : *A*, genitalia of male; *B*, ventrai aspect of portion of tip of abdomen of female.

FEMALE. In all respects like the female of *E. longiceps*, except for the unusual size of a structure (Fig. 13*A*, *s*), in all probability the spermatheca, which lies within the body on the median line above the genital plate. In related species this structure, while present, is very small.

NOTES.—This species is obviously nearest *E. extremus*, but the differences between the two, while small, appear to be constant and are quite definite.

9. **Enderleinellus platyspicatus** n. sp.

FIGS. 14, 15.

HOST OF THE TYPE. *Funambulus tristriatus*, Colombo, Ceylon. Holotype, a female.

SPECIMENS EXAMINED. From the above host and locality only.

FEMALE (Fig. 14). *Length* 0.5 mm. *Head* short, only slightly broader than long. Anterior margin rounded, lateral margins nearly par-

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. Antennæ set well toward the anterior margin. Rostrum on the ral side at a slight distance from the apex of the head. Ventral side he head with numerous, small, chitinized areas. *Thorax* about as as and only slightly wider than the head. Sternal plate (Fig. 15*A*) ll, quadrate, the anterior angles slightly produced, the anterior margin rginate. Posterior femora with three tooth-like processes on the an- ır margin and the posterior tarsi with a similar process at the outer rior angle.

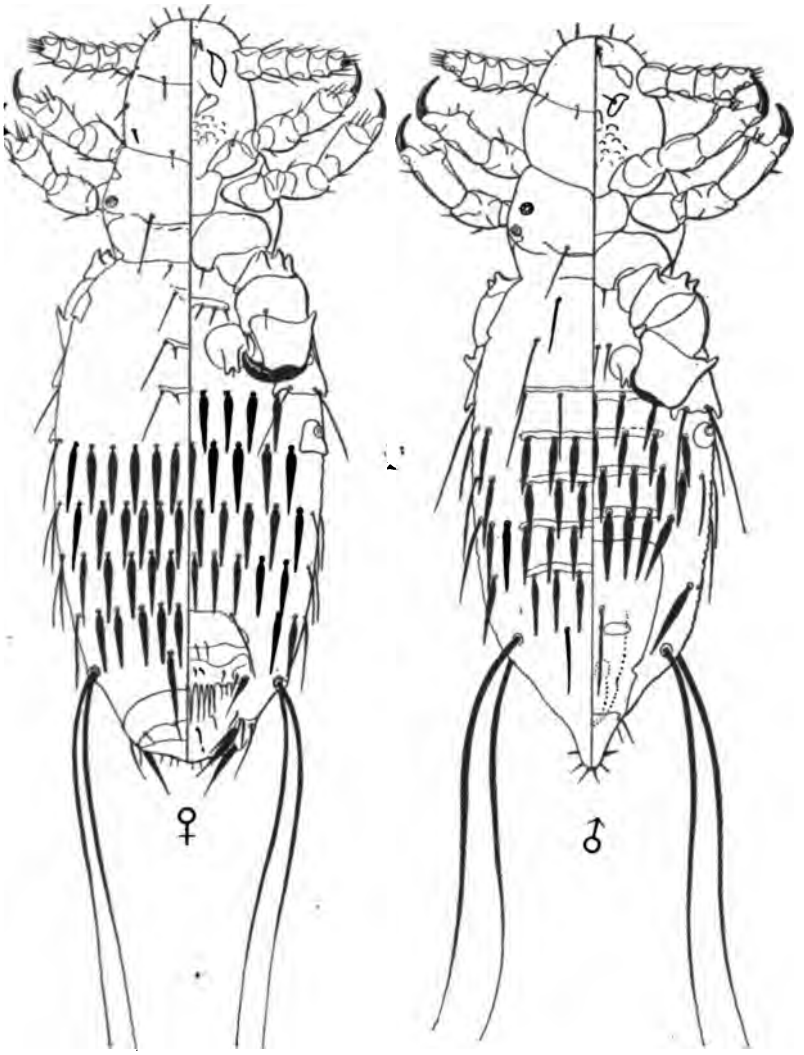

Fig. 14.—*Enderleinellus platyspicatus* n. sp.

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Abdomen elongate-oval, rather slender, the apex rounded or slightl truncate. Pleural plates (Fig. 15*B*) present on the second to fourth seg ments only, the first and third plates quite small, the second much large and bearing a pair of quite long spines on the posterior margin. Spiracl apparently present only in connection with the last two pairs of pleur plates, moderately large and conspicuous. Tergites unchitinized exce for a very small sclerite occupying the median fourth of each of the fir three segments and a broad sclerite which extends entirely across t ninth segment. First segment with a median pair of small, slender spine second and third with a median pair of extremely minute spines, and ou side of these a pair of slender spines. Fourth to seventh segments ea

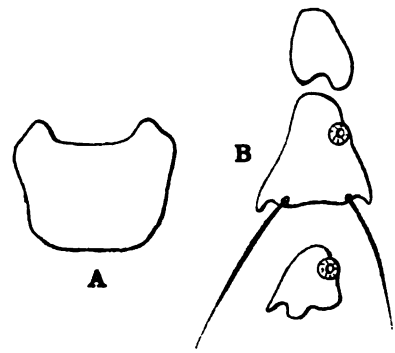

Fig. 15.—*Enderleinellus platyspicatus* n. sp.: *A*, sternal plate; *B*, pleural plates.

with a continuous transverse row of twleve to fourteen large, flattene spines which are broadest near the base and taper regularly to the blu apex. Eighth segment with a median pair of such spines and a pair c very long, slender setæ at each lateral margin. On the ventral side th first segment bears a small transverse sclerite with six small spines, th remainder being unchitinized, except for the genital plate. Third to sixt segments each with an unbroken row of eight to twelve spines similar t those on the dorsum. Seventh segment with a submarginal pair of suc spines on each side. Genital plate occupying most of the seventh ster nite, divided transversely into two plates. The posterior plate bears long fringe on its posterior margin and a single flattened spine at eac posterior angle. The apex of the abdomen bears a flattened spine at eac angle and anterior to this spine are two more of similar character.

Male (Fig. 14). In general resembling the female but with th apex of the abdomen sharply pointed. Third to seventh tergites eac with a narrow sclerite occupying the median half of the segment. Spine slightly fewer than in the female, the rows tending to be broken int median and submarginal series. On the ventral side the arrangemer

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of the spines is much as on the dorsum, the third to sixth sternites bearing a small transverse sclerite. Genital plate quite large, extending forward to the anterior margin of the sixth segment.

Genitalia not available for description.

NOTES.—The single specimen found of the male of this species was unfortunately destroyed by accident before a drawing of the genitalia could be made.

The only species at all closely resembling this is *E. dremomydis* n. sp. The curiously flattened spines are quite distinctive.

10. Enderleinellus dremomydis n. sp.

FIG. 16.

HOST OF THE TYPE. *Dremomys pernyi*, West Szechuan, China. Holotype, a female.

SPECIMENS EXAMINED. From the above host and locality only.

FEMALE (Fig. 16*A*). *Length* 0.55 mm. *Head* short, only slightly longer than broad, the anterior margin rounded, the lateral margins nearly parallel. Rostrum on the ventral side at a slight distance from the anterior margin. Antennæ set well toward the apex of the head. *Thorax* slightly shorter than the head, the sternal plate (Fig. 16*C*) more or less oval, slightly wider than long, with the anterior margin slightly emarginate; legs of the usual type, the posterior femora with three tooth-like processes on the anterior margin.

Abdomen elongate-oval, the posterior extremity more or less truncate. Pleural plates (Fig. 16*B*) present on the second to sixth segments, each with a pair of small spines on the posterior margin, except the first, which has but a single spine. Spiracles quite small, present on the third to eighth segments. Tergites entirely unchitinized. First to fifth segments each with a median group of four small, slender spines. Fifth with a submarginal pair of short, flatteened, sharply pointed spines. Fifth to seventh each with an unbroken row of ten to fourteen large, stout, sharply pointed spines. Eighth with a median pair of such spines. Seventh with a marginal pair of moderately long, slender setæ; eighth with a marginal pair which are considerably longer than those of the seventh.

On the ventral side the third tergite alone bears a narrow, transverse sclerite. First sternite with a median group of four slender spines. Third and fourth with median group of six short, flattened, sharply pointed spines. Fifth and sixth with twelve such spines which are somewhat longer than those of the preceding segments. Seventh with a single large, submarginal spine on each side. Genital plate occupying the greater part of the seventh sternite. Posterior end of the abdomen with

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a small lobe-like process at each angle which bears a single stout Anterior to this process is a cluster of several smaller spines.

MALE. Not available for description.

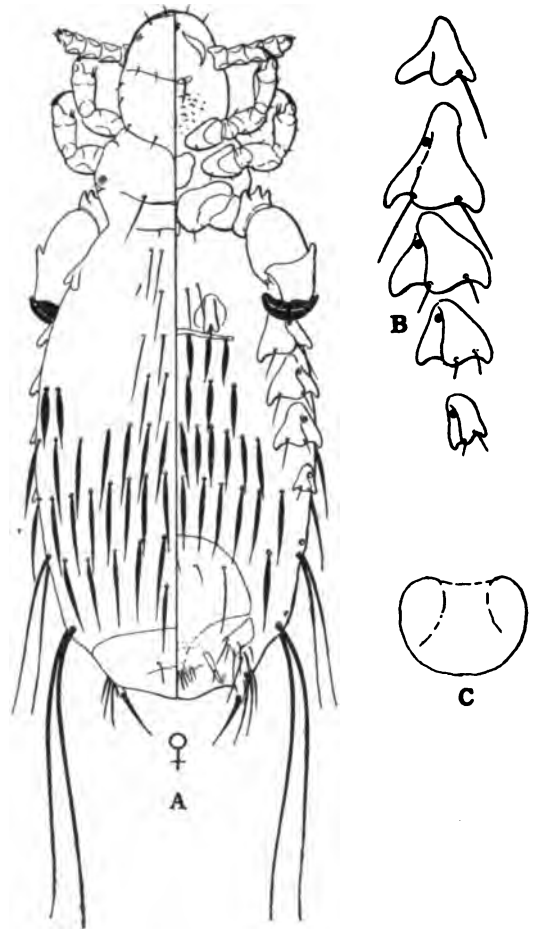

Fig. 16.—*Enderleinellus dremomydis* n. sp.: *A*, female; *B*, pleural plates; *C*, plate.

NOTES.—This species is possibly closest to the preceding, *E. platys* but the presence of five pairs of pleural plates is alone sufficient to disting

11. **Enderleinellus nannosciuri** n. sp.

FIG. 17.

HOST OF THE TYPE. *Nannosciurus melanotis*, Batavia, Java. type, a female.

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SPECIMENS EXAMINED. From the above host and locality only.

FEMALE (Fig. 17*A*). *Length* 0.5 mm. *Head* somewhat elongate, considerably narrower in front of the antennæ than behind, the anterior margin pointed or narrowly rounded. Rostrum close to the apex of the head. *Thorax* slightly shorter than the head. Sternal plate (Fig. 17*B*)

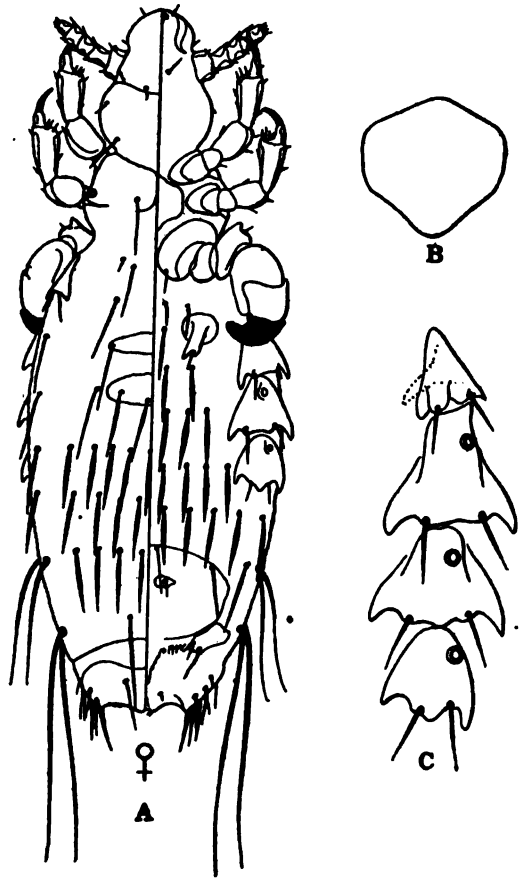

Fig. 17.—*Enderleinellus nannosciuri* n. sp.: *A*, female; *B*, sternal plate; *C*, pleural plates.

quadrate, with the anterior and posterior margins slightly produced medially. Legs of the usual type, the posterior femora with a single tooth-like process on the anterior margin.

Abdomen elongate-oval, the posterior extremity truncate. Pleural plates (Fig. 17*C*) present on the second to fifth segments, all relatively quite large and with a pair of short spines on the posterior margin. Spiracles quite small, apparently present only in connection with the last

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three pairs of pleural plates. Tergites unchitinized except for a rathe large, oval sclerite which occupies the median third of the third an fourth segments. Spines arranged as follows. First, second, and thir segments each with a median group of two slender spines. Fourth wit median group of six spines. Fifth, sixth, and seventh each with transverse row of eight to twelve quite large, stout, and sharply pointe spines, the submarginal spine on the fifth and sixth segments somewha separated from the others. Second, third, and fourth segments each wit a single slender, submarginal spine. Eighth segment with a media pair of spines. Seventh with a pair of slender, moderately long setæ a each lateral margin; eighth with similar but much longer setæ.

On the ventral side the arrangement of the spines is practically as c the dorsum. None of the sternites is chitinized, except for the genit plate which occupies most of the seventh segment. Apex of the abdom with the angles not produced into a lobe-like process but bearing a clust of quite stout spines.

MALE. Not available for description.

NOTES.—In the absence of the male it is difficult to indicate the affinities of t species. It is possibly closest to the preceding, *E. dremomydis*, but this is at best only a surmise.

12. **Enderleinellus zonatus** n. sp.

FIGS. 18, 19.

HOST OF THE TYPE. *Paraxerus jacksoni capitis*, Kijabe, British E Africa. Holotype, a female. Allotype from *Parasciurus animosus*, M Lolokroi, British East Africa.

SPECIMENS EXAMINED. From the following: *Paraxerus jacksc capitis*, Kijabe, British East Africa; *Paraxerus palliatus suahelicus*, Briti East Africa; *Paraxerus palliatus ornatus*, Ngoye Hills, Zululand, Sou Africa; *Parasciurus animosus*, Mt. Lolokroi, British East Africa.

FEMALE (Fig. 18). *Length* 0.6 mm. *Head* quite short, but lit longer than broad, with the anterior margin broadly rounded, the later margins nearly parallel. Antennæ set well toward the apex of the hea Rostrum on the ventral side of the head, at a slight distance from t anterior margin. *Thorax* about as long as the head; sternal plate (Fi 19*C*) quadrate, with the anterior angles somewhat produced and the a terior margin emarginate; legs of the usual type, the posterior femo with a pair of tooth-like processes on the anterior margin, the posteri tarsus with a similar process at the outer anterior angle.

Abdomen elongate-oval, the posterior extremity truncate. Pleur plates (Fig. 19*B*) present on the second to fourth segments only, t second pair bearing a pair of moderately long spines on the posteri

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margin. Spiracles quite small, present only on the last two pleural plates. Second and third tergites each with a weakly chitinized area occupying the median half of the segment. Fourth with a chitinized area occupying

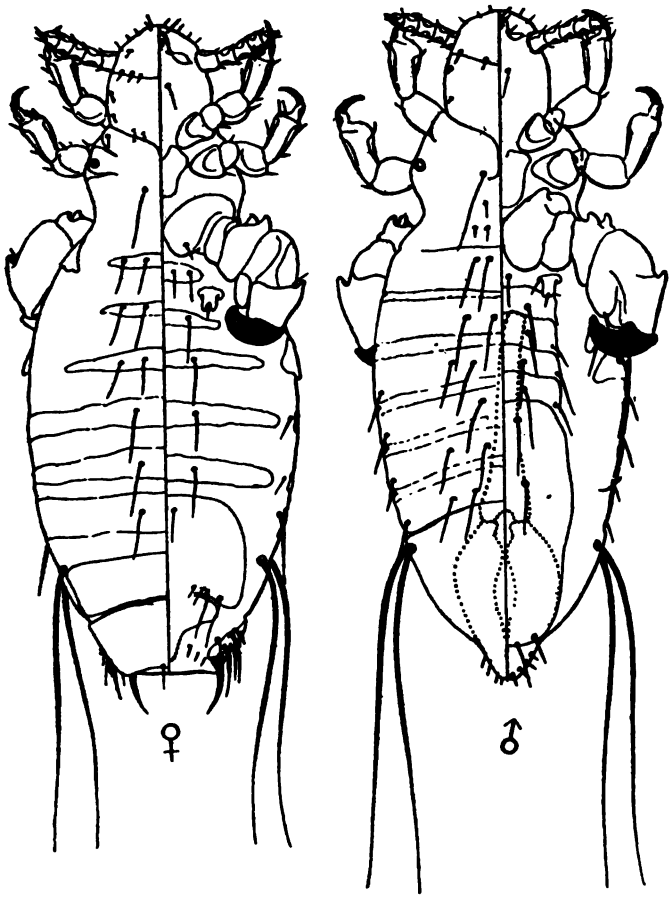

Fig. 18.—*Enderleinellus zonatus* n. sp.

nearly the entire width of the segment. Fifth to eighth each with a weakly chitinized area extending entirely across the segment, thus giving the abdomen a banded appearance. Spines very few, small and slender, confined to a median group of two to four on each segment. Eighth segment with a pair of long, slender setæ at each lateral margin.

Ventral side similar to the dorsal except that the chitinized areas do not reach to the lateral margin on any segment. Genital plate very large, occupying most of the seventh and eighth segments. The pair of sclerites with their projecting processes on the second sternite are unusually small.

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End of the abdomen without lobe-like processes at the angles but with single large, stout spine and several smaller spines in this region.

MALE (Fig. 18). *Length* 0.5 mm. For the most part resembling the female but with the end of the abdomen sharply pointed. The transverse bands are wider, leaving only small, unchitinized intersegmental spaces. The spines are somewhat more numerous, there being a submarginal spine at each lateral margin of the fourth to seventh segments. On the ventral side the third to sixth sternites each bear a chitinized area which occupies the median half of the segment. These sternites together occupy only the anterior half of the venter, the remainder being taken up by the extraordinarily large genital plate.

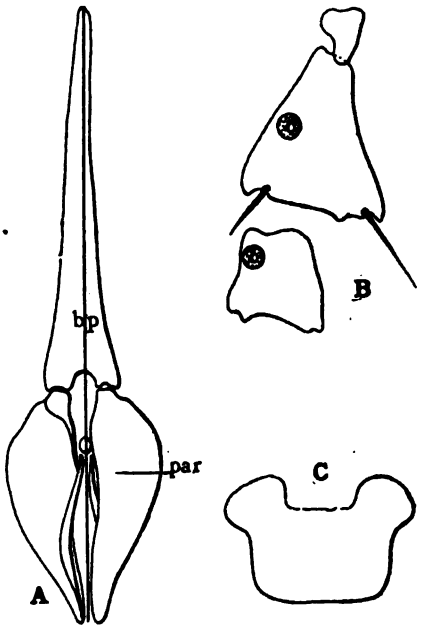

Fig. 19.—*Enderleinellus zonatus* n. sp.: *A*, genitalia of male; *B*, pleural plate; *C*, sternal plate.

Genitalia (Fig. 19*A*) unusually large and conspicuous, the basal plate extending almost to the posterior margin of the thorax. Basal plate (*bp*) a slender rod which is somewhat expanded and slightly bifid at its posterior extremity. To the end of the basal plate articulate the very large, flattened, and tapering parameres (*par*). The amount of material at hand is not sufficient to permit of dissections, and it has not been possible to work out the remaining parts.

NOTES.—A very singular and isolated species, bearing no very close resemblance to any others that I have seen. The banded appearance, the paucity of spines and the extraordinary genitalia of the male are all quite distinctive.

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13. Enderleinellus sciurotamiasis n. sp.

FIGS. 20, 21.

HOST OF THE TYPE. *Sciurotamias dravidianus,* Shensi, China. Holotype, a male.

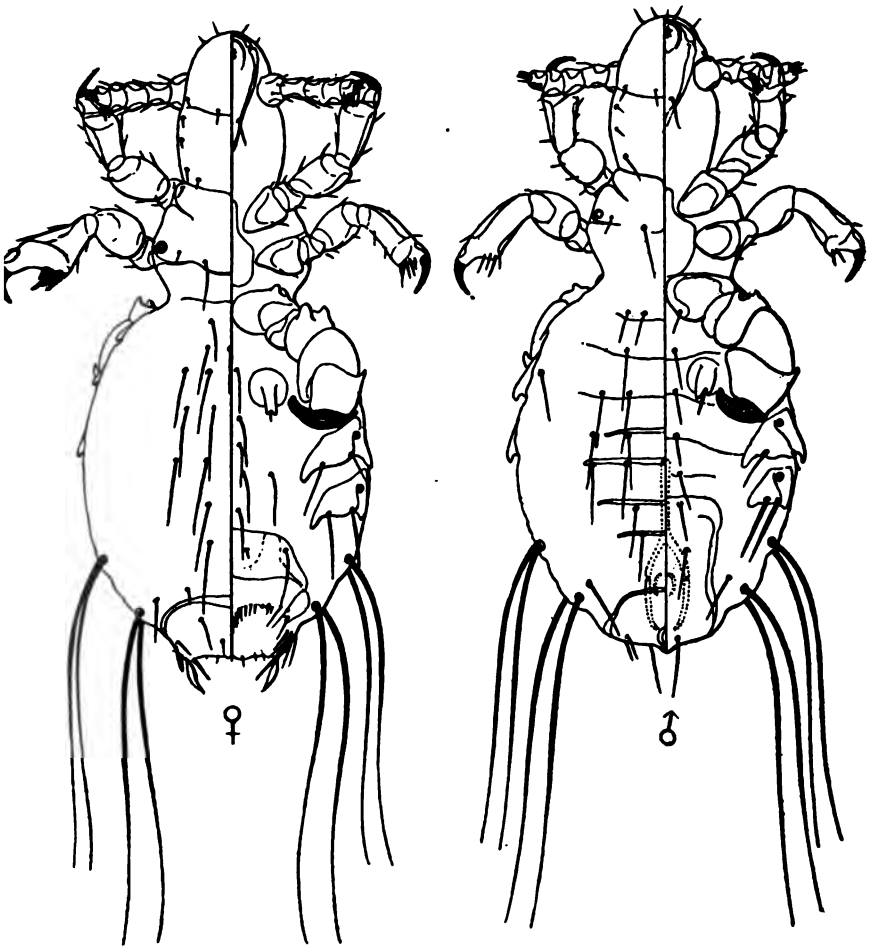

Fig. 20—*Enderleinellus sciurotamiasis* n. sp.

SPECIMENS EXAMINED. From the above host and locality only.

MALE (Fig. 20). *Length* 0.55 mm. *Head* elongate, about twice as wide as long. Anterior margin quite sharply rounded, lateral margins nearly parallel. Antennæ set well back from the apex of the head. Rostrum on the ventral side at a slight distance from the apex of the

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head. In front of the rostrum is a narrow sclerite which borders the anterior margin of the head, and articulating to the end of this sclerite there is on each side another narrow sclerite which extends posteriorly toward the median line for nearly half the length of the head.

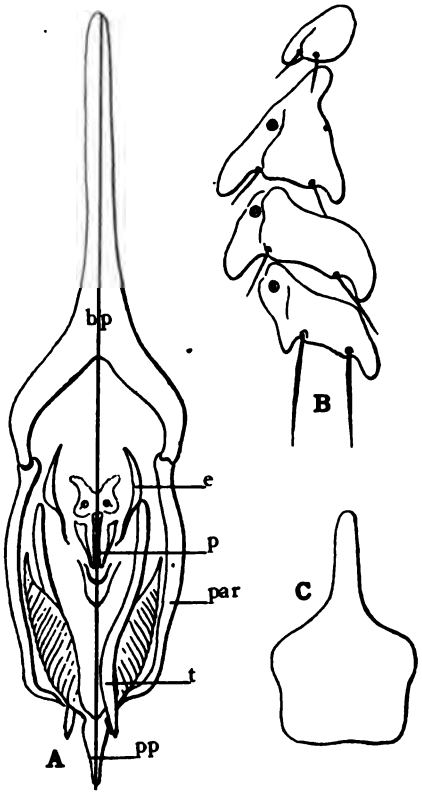

Fig. 21.—*Enderleinellus sciurotamiasis* n. sp.: *A*, genitalia of male; *B*, pleural plates; *C*, sternal plate.

Thorax considerably shorter than the head. Sternal plate (Fig. 21*C*) spatulate, having a handle-like portion which extends forward between the anterior coxæ. Legs of the usual type, the posterior femora with a pair of tooth-like processes on the anterior margin, the posterior tarsi with a similar process at the outer anterior angle.

Abdomen broadly oval. Pleural plates (Fig. 21*B*) present on the second to fifth segments. Each plate with a pair of spines on the posterior margin, those of the last pair larger and stouter than the others. Spiracles quite small, present only in connection with the last three pairs of pleural plates. Dorsum with a narrow sclerite occupying the median third or fourth of the fourth to seventh segments and with a very narrow

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sclerite extending entirely across the ninth segment. Spines few and small. Third and eighth segments with a single, submarginal spine on each side. Second to seventh segments each with a median group of two to four spines. Seventh and eighth segments each with a pair of long, slender setæ at each lateral margin.

On the ventral side none of the sternites are chitinized, and each segment bears only a median pair of spines. The genital plate consists of a narrow, transverse sclerite occupying the median third of the seventh sternite, with its ends produced back to meet the lateral margin of the ninth segment.

Genitalia (Fig. 21*A*). The basal plate (*bp*) consists of a long, slender piece which is expanded and quite deeply bifid at its posterior end. To the arms attach the slender parameres (*par*) which are more than half as long as the basal plate. Between the tips of the parameres, which are turned toward each other, lies the pseudo-penis (*pp*), the arms of which are set at an acute angle to each other, are flattened, expanded, and transversely striate. Also between the parameres are two slender rods (*t*) which are perhaps the telomeres. What are possibly the endomeres (*e*) are two slender pieces between which lie a complex of structures which appear in part at least to be the penis (*p*).

FEMALE (Fig. 20). *Length* 0.6 mm. In all respects quite closely resembling the male, but with none of the tergites chitinized. Tip of the abdomen truncate, the angles without lobe-like processes but with a cluster of spines of which two or three are flattened and expanded.

NOTES.—An isolated species, apparently not closely related to any other that I have seen.

14. **Enderleinellus euxeri** n. sp.

FIGS. 22, 23.

HOST OF THE TYPE. *Euxerus microdon,* Wambugu and Oni, British East Africa. Holotype, a male, from the first named locality.

SPECIMENS EXAMINED. Only as above recorded.

MALE (Fig. 22). *Length* 0.9 mm. *Head* elongate, the apex sharply pointed, the lateral margins behind the antennæ nearly parallel. Antennæ unusually slender, set about the middle of the head. Rostrum close to the apex. The entire head is quite heavily chitinized, especially on the dorsal side.

Thorax slightly shorter than the head. Sternal plate (Fig. 23*B*) quadrate, the angles rounded. Legs unusually large, especially the posterior pair.

Abdomen almost subcircular, the posterior extremity slightly pointed.

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Pleural plates (Fig. 23*C*) present on the second to seventh segment The first pair is very small; second pair large and bi-lobed, a very lon slender seta arising from the apex of one lobe. Remaining plates on lobed, being successively smaller, the seventh being very small. Spiracl

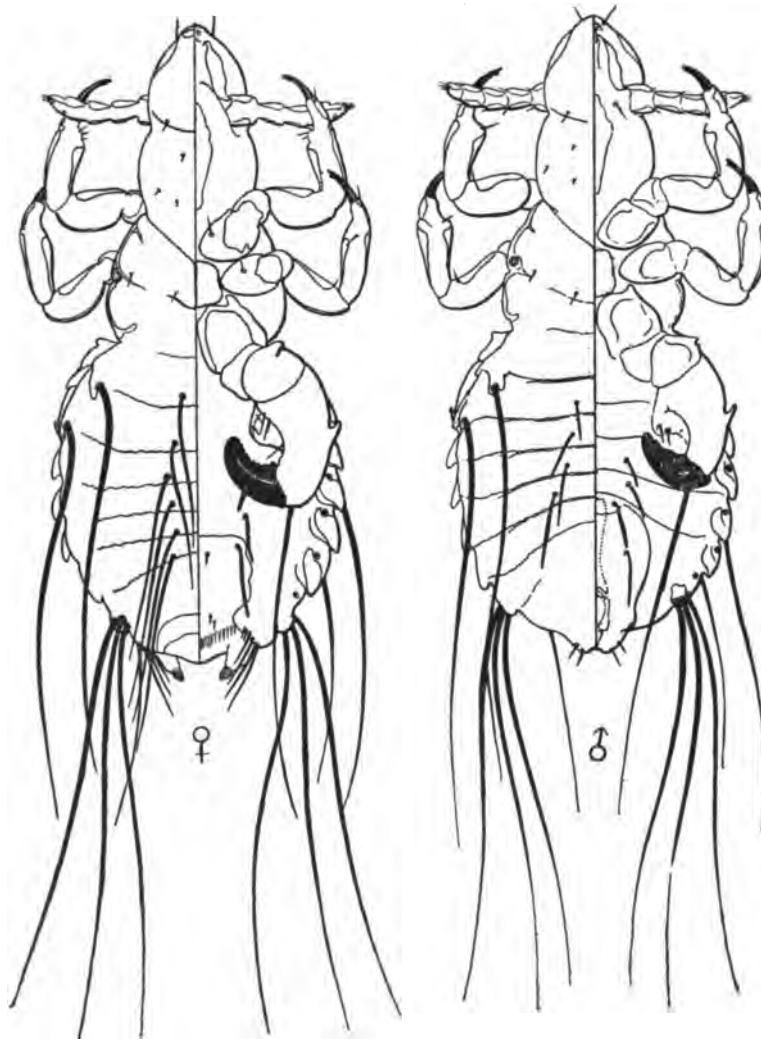

Fig. 22.—*Enderleinellus euxeri* n. sp.

small, present in connection with the second to seventh pleural plate The derm is everywhere slightly chitinized and presents a minutely pa pilate appearance. Spines few, arranged as follows. Second and thi segments each with a single very long, slender seta near each later margin. Third to sixth each with a median pair of rather short, sto

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spines. Eighth with two or three very long, slender setæ at each lateral margin. On the ventral side there are only a median pair on the fifth and sixth segments and two median pairs on the genital plate. The pair of sclerites usually present on the second sternite is lacking.

Genitalia (Fig. 23*A*). Relatively small. Basal plate (*bp*) a simple rod, which is expanded and quite deeply bifid at the tip. Parameres (*par*) short and broad. Beyond the ends of the parameres is the short, wedge-shaped pseudo-penis (*pp*), and between the parameres are two proximally fused pieces which are perhaps the endomeres (*e*). Overlying the ends of the parameres and the pseudo-penis is a U-shaped piece (*t*) of doubtful homology, but possibly representing the telomeres.

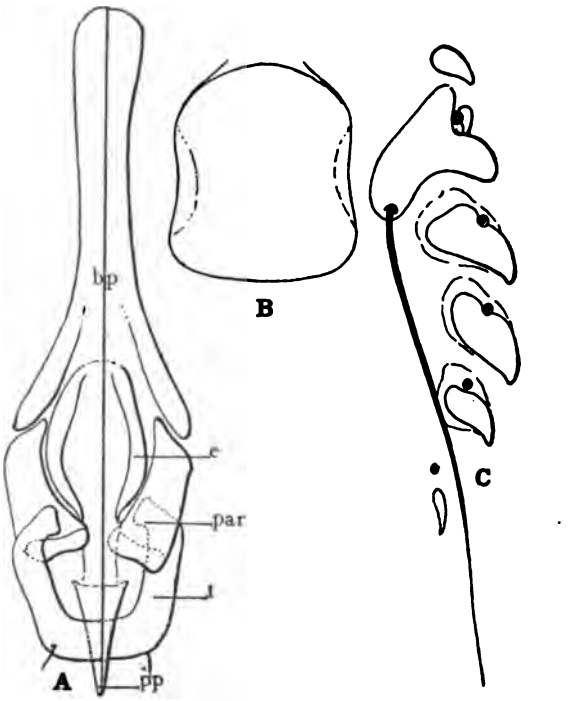

Fig. 23.—*Enderleinellus euxeri* n. sp.: *A*, genitalia of male; *B*, sternal plate; *C*, pleural plates.

FEMALE (Fig. 22). *Length* 1 mm. In general closely resembling the male, but having the median spines of the dorsum long and slender. End of the abdomen rounded, bearing a pair of lobe-like processes, each of which terminates in a short, flattened, blunt spine.

NOTES.—A most anomalous species, differing from all the other members of the genus in the absence of the paired plates on the second sternite as well as in several other important characters. I am unable to suggest its relationships unless they be with the following species, *E. heliosciuri* n. sp.

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15. Enderleinellus heliosciuri n. sp.

FIGS. 24, 25.

HOST OF THE TYPE. *Heliosciurus undulatus daucinus,* Mazer. British East Africa. Holotype, a male.

SPECIMENS EXAMINED. From the type host and the following: *He osciurus rufobrachiatus nyansæ,* Lukosa River, British East Afric *H. multicolor madigæ,* Uma, Uganda, Africa; *H. ruwenzorii,* Mut ku Valley, Mt. Ruwenzori, British East Africa; *Protoxerus stang bea,* Lukosa River, British East Africa.

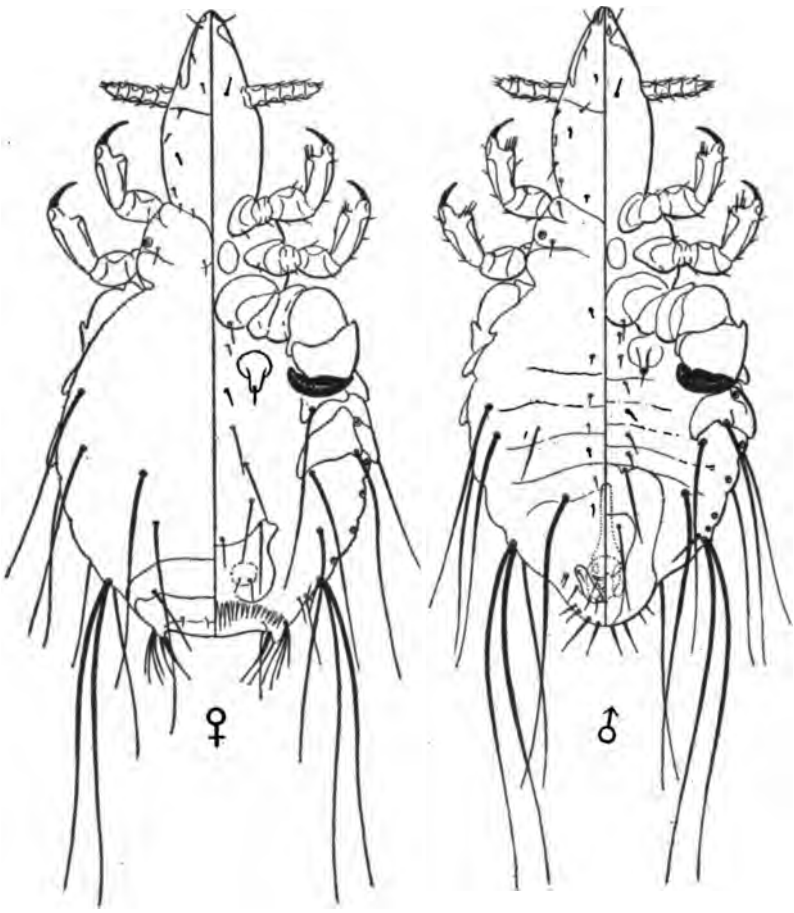

Fig. 24.—*Enderleinellus heliosciuri* n. sp.

MALE (Fig. 24). *Length* 0.85 mm. *Head* elongate, more th twice as long as wide, cigar-shaped, the apex sharply pointed. Ant

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næ relatively small, set slightly in advance of the middle of the head. Rostrum at the apex of the head. *Thorax* less than half as long as the head. Sternal plate (Fig. 25*B*) divided into two small oval sclerites. Legs of the usual type, but the posterior femora without tooth-like projections on the anterior margin.

Abdomen broadly oval, its posterior extremity somewhat pointed. Pleural plates (Fig. 25*A*) present on the second to fourth segments, short and broad, the last two with a single long, slender seta on the posterior margin. Spiracles quite small, present on the second to eighth segments. Dorsum entirely without chitinized areas. Spines very few, arranged as follows: fourth (?) and fifth (?) segments each with a single, long, slender submarginal seta, fifth with a single rather large spine

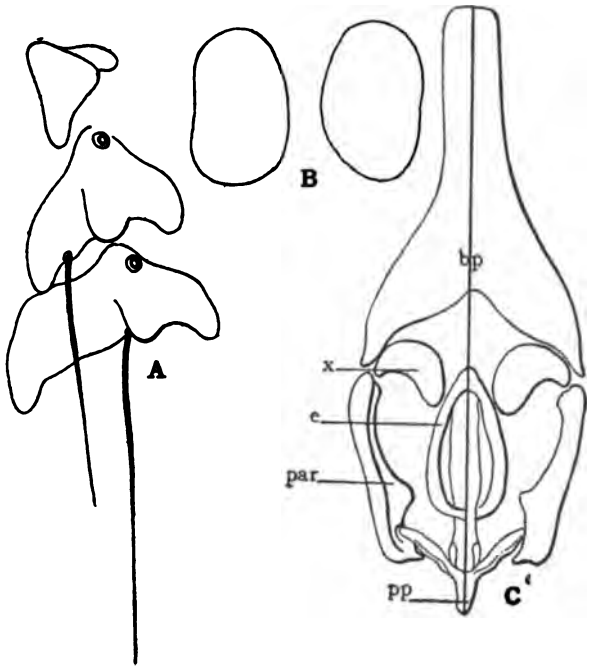

Fig. 25.—*Enderleinellus heliosciuri* n. sp.: *A*, pleural plates; *B*, sternal plate; *C*, genitalia of male.

about half way between the margin and the median line. Seventh with a long, slender seta in the same position. Eighth with a pair of very long, slender setæ at each lateral margin.

On the ventral side each segment bears a median pair of short spines. The fifth and seventh segments each bear a long, slender seta near each lateral margin.

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Genitalia (Fig. 25*C*). Basal plate (*bp*) a rather short, broad piece which is much expanded and shallowly bifid at the posterior end. Parameres (*par*) about half as long as the basal plate, nearly straight. Between the tips of the parameres is the small pseudo-penis (*pp*), the arms of which meet a small, subapical depression in the parameres. Between the proximal ends of the parameres are two small, curved pieces (*x*) of doubtful homology. Likewise between the parameres is an oval, ring-shaped piece (*e*), which is perhaps formed by the fusion of the endomeres. Extending from the anterior end of the endomeral piece to the pseudo-penis is a narrow, indistinct sclerite of doubtful homology.

FEMALE (Fig. 24). *Length* 1 mm. In general quite closely resembling the male, but with a transverse sclerite extending across the ninth segment with the end of the abdomen truncate and with a slightly different arrangement of the setæ on the dorsum. There is a tendency for the spine on the second pleural plate to become a long, slender seta, although it is sometimes quite short. End of the abdomen with a small, lobe-like process at each angle, this bearing a single stout spine.

NOTES.—In the specimens from *Protoxerus* the spines of the median groups, both dorsally and ventrally are larger than in the type but there is obviously some variation and this difference is probably not significant.

This is an isolated species, possibly closest to *E. euxeri*, but yet quite different.

16. Enderleinellus suturalis (Osborn)

FIGS. 26, 27, 28.

1891. *Hæmatopinus suturalis* Osborn, *U. S. Dept. Agric., Div. Ent., Bul.* 7 o. s.: 27, f. 15.
1896. *Hæmatopinus suturalis* Osborn, Osborn, *U. S. Dept. Agric., Div. Ent., Bul.* n. s.: 185, f. 109.
1904. *Polyplax* (?) *suturalis* (Osb.), Enderlein, *Zool. Anz.*, **28**: 143.
1908. *Polyplax* (?) *suturalis* (Osb.), Dalla Torre, Anoplura, 14, Gen. Ins.
1915. *Enderleinellus suturalis* (Osb.), Kellogg and Ferris, Anoplura and Mall. N. Am. Mammals, 40–42; pl. 4, f. 9. Stanford Univ. Publ.
1915. *Enderleinellus suturalis* var. *occidentalis* Kellogg and Ferris, *ibid.*, 42; pl. 2, f. 3; pl. 4, f. 10; pl. 5, f. 17.
1916. *Enderleinellus suturalis* (Osb.), Ferris, Cat. Anoplura, *Proc. Cal. Acad. Sci.* (4), **6**: 149.
1916. *Enderleinellus suturalis* var. *occidentalis* K. and F., Ferris, *ibid.*, 150.
1916. *Enderleinellus suturalis* (Osb.), Ferris, *Psyche*, **23**: 108.

HOST OF THE TYPE. In the original description this species was recorded from *Citellus* (= *Spermophilus*) *franklini* and *C. 13-lineatus*, at Ames, Iowa. The former may be considered as the type host, and it is upon specimens from this host that the present figures and description are based.

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SPECIMENS EXAMINED. From *Citellus beldingi,* Tuolumne Meadows, California; *C. elegans,* Sulphur Springs, Colorado; *C. eversmanni,* Altai, Siberia; *C. franklini,* Walhalla, North Dakota; *C. mollis,* Virginia Valley, Nevada; *C. mongolicus,* Kansu, China; *C. osgoodi,* near Circle, Alaska; *C. townsendi,* Wallula, Wash.; *Citellus tridecimlineatus pallidus,* Pendennis, Kan., and *C. tridecimlineatus texensis,* Mt. Scott, Oklahoma; *Callospermophilus chrysodeirus,* California; *C. castanurus,* Park City, Utah; *C. madrensis,* Sierra Madre, Chihuahua, Mexico; *Ammospermophilus nelsoni,* Bakersfield, Cal.; *Cynomys gunnisoni,* Florissant, Colo.; *C. leucurus,* Routt County, Colorado, and near Independent Rock, Wyo.

FEMALE (Fig. 26). *Length* 0.8 mm. *Head* elongate, at least twice as

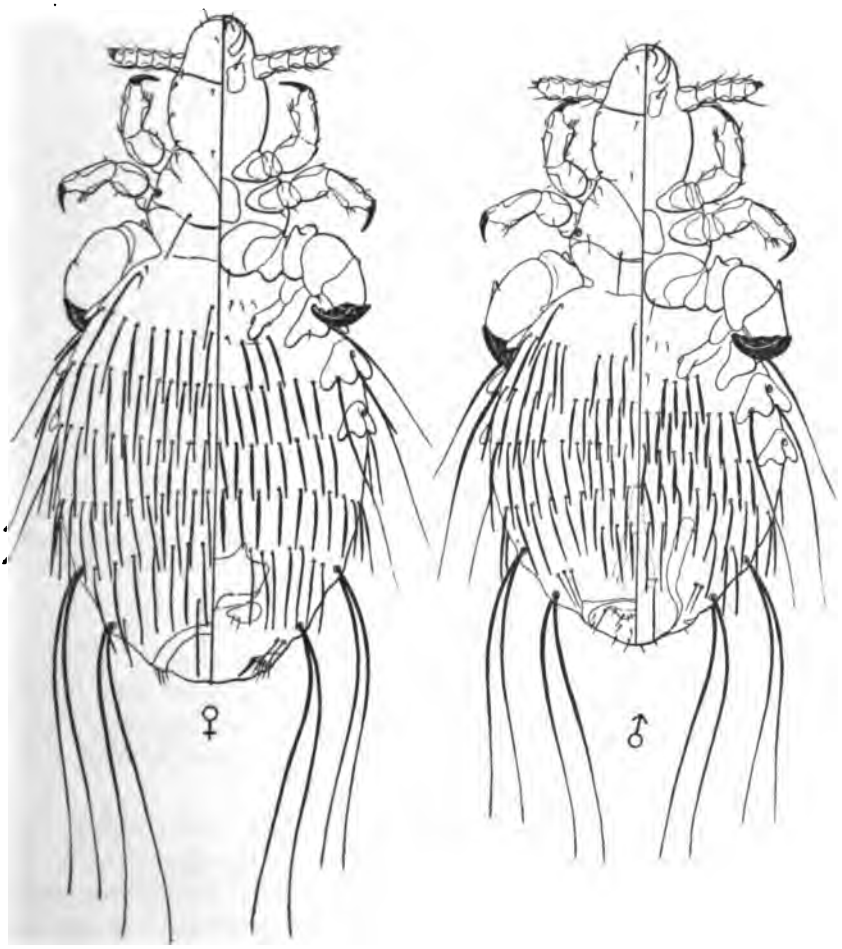

Fig. 26.—*Enderleinellus suturalis* (Osborn): figure from specimens taken from *Citellus franklini,* Walhalla, North Dakota.

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long as wide, the apex rounded or slightly pointed and more or less deflexed. Head widening somewhat behind the antennæ, the margins nearly parallel. The post-antennal suture is unusually well defined. On the ventral side the rostrum, which is situated near the apex, is almost surrounded by a ring-like sclerite. Antennæ set slightly in advance of the middle of the head.

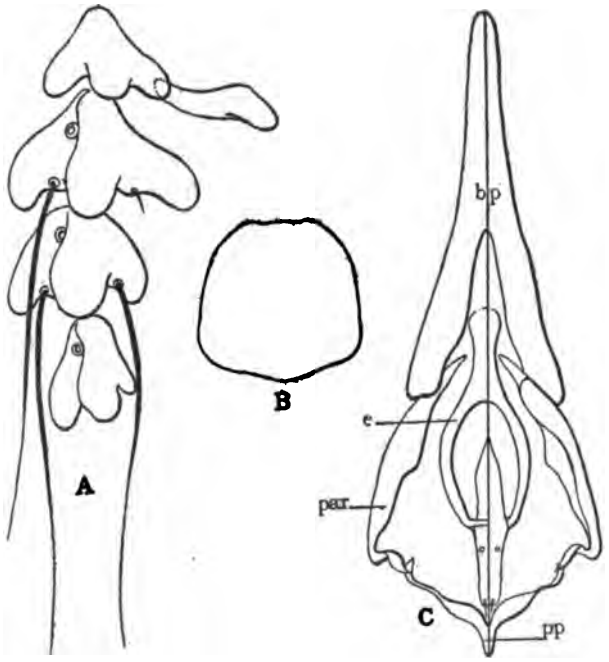

Fig. 27.—*Enderleinellus suturalis* (Osborn): *A*, pleural plates; *B*, sternal plate; *C*, genitalia of male. Figures from specimens taken from *Citellus franklini*, Walhalla, North Dakota.

Thorax somewhat shorter than the head. Sternal plate (Fig. 27*B*) more or less quadrate, the anterior end slightly narrower than the posterior. Legs of the usual type, the posterior femora with a single tooth-like process on the anterior margin, the posterior tarsi without such a process at the outer anterior angle.

Abdomen broadly oval or subcircular, the posterior extremity rounded. Pleural plates (Fig. 27*A*) present on the second to fifth segments, quite large, each with the posterior angles produced and broadly rounded and with a median lobe on the posterior margin. Second pair with a single seta and a very small spine on the posterior margin, third pair with two long, slender spines. Derm membranous through-

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out except for a narrow transverse sclerite extending across the ninth tergite. Spines extremely numerous, all quite long and stout. On the dorsum the arrangement is as follows: First segment with a single submedian spine and a median pair of small spines. Ninth with a median pair. Remaining segments with an unbroken row of eighteen to twenty-four spines. Seventh and eighth segments each with a pair of long, slender setæ at each lateral margin.

On the ventral side the arrangement of the spines is much as on the dorsum, but all the spines tend to be somewhat shorter and stouter. The paired sclerites on the second sternite are produced laterally, reaching to the first pair of pleural plates, with which they are closely associated, although they are not actually attached. The genital plate is rather small, occupying the median half of the eighth segment. The end of the abdomen bears a pair of short stout spines which are sometimes seen at some distance from the margin.

MALE (Fig. 26). *Length* 0.75 mm. In general very closely resembling the female but with the abdomen slightly more pointed. The genital plate consists merely of a pair of narrow sclerites which extend forward from the margin of the ninth segment to the middle of the seventh sternite.

Genitalia (Fig. 27*C*). Basal plate (*bp*) a simple rod which is expanded and deeply bifid posteriorly. Parameres (*par*) about half as long as the basal plate, diverging posteriorly, with their tips bent toward each

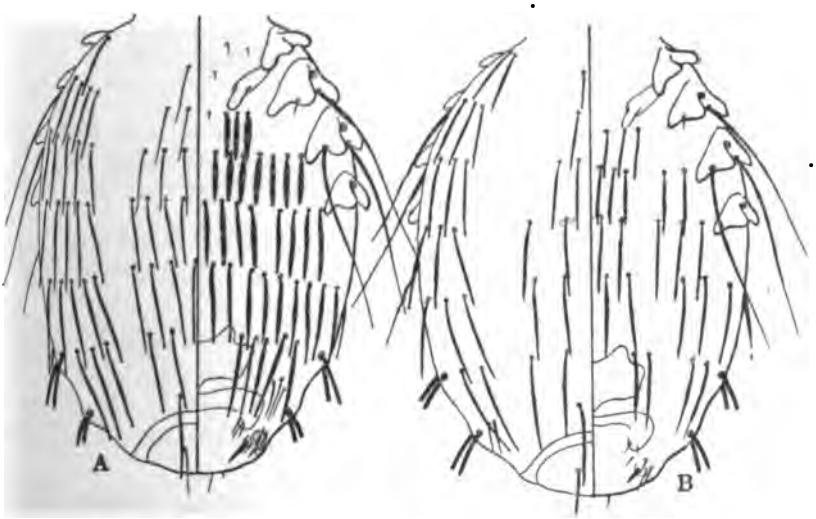

Fig. 28.—*Enderleinellus suturalis* (Osborn): *A*, abdomen of female from *Citellus beldingi*, California; *B*, abdomen of female from *Cynomys leucurus*, Wyoming.

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other. Between the tips lies the small pseudo-penis (*pp*). Between t parameres is an oval, ring-like piece (*e*), which perhaps represents t fused endomeres. Overlying the posterior portion of the endomeral pie is a small, flattened, elongate sclerite of doubtful homology. The post rior extremity of this piece is blunt and is tipped by a pair of sma spines.

NOTES.—I am including under this species forms, the extremes of which a sufficiently different perhaps to merit recognition as species. However, the extremes are connected by a series of intermediate forms so complete that t limits of these species would be scarcely possible of definition. I therefore reta them as one species; but I shall point out the differences.

The form described above is the typical form. This occurs on *Citellus fran lini, C. tridecimlineatus, Ammospermophilus nelsoni* and the various species *Callospermophilus*. Specimens from *Callospermophilus* have previously been sep rated by Kellogg and Ferris as the variety *occidentalis*, but this is quite untenab

The specimens from *Citellus beldingi* (Fig. 28 *A*) have the dorsal spin noticeably fewer, more slender and tending to be arranged in marginal and medi series. Also the ventral spines are much shorter and stouter than those of t dorsum. With these specimens those from *Citellus eversmanni, Citellus mol C. elegans*, and probably those from *Citellus mongolicus* (represented only males) agree quite closely.

The specimens from *Citellus osgoodi* and *C. townsendi* are similar to tho from *Citellus beldingi* in the paucity and slenderness of the dorsal spines, but ha the ventral spines longer and relatively more slender.

The specimens from the genus *Cynomys* (Fig. 28 *B*) all agree in having th dorsal spines few and slender as in those from *Citellus beldingi*, but the vent spines are likewise small and slender, differing but little from those of the dorsu

17. **Enderleinellus osborni** Kellogg and Ferris.

FIG. 29.

1915. *Enderleinellus osborni* Kellogg and Ferris, Anoplura and Mall. N. Am Mam., 43–44; t. f. 15; pl. 4, f. 11; pl. 6, f. 6, Stanford Univ. Publ.

1916. *Enderleinellus osborni* K. and F., Ferris, Cat. Anoplura, *Proc. Cal. Acad Sci.* (4) **6**: 148.

HOST OF THE TYPE. *Citellus douglasi*, Covelo, Mendocino County, California. In Ferris, Cat. Anoplura, the host is erroneously stated to be *Citellus beecheyi*.

SPECIMENS EXAMINED. From *Citellus douglasi*, Cazadero and Covelo, Calif.; *C. beecheyi beecheyi*, Carmel Point, Monterey County, Calif.; *C. beecheyi fisheri*, Pleasant Valley, Mariposa County, Calif.; *C. grammurus*, Oracle, Ariz.; *C. buckleyi*, Llano, Texas; *Xerospermophilus tereticaudus*, Imperial County, Calif.

FEMALE (Fig. 29). Definitely separable from *E. suturalis* only by the fact that the fourth tergite bears a median group of from two to six long, slender setæ. The type of this species differs further from *suturalis* in that the spines, both of dorsum and venter, are much fewer

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and are much shorter and stouter. In specimens from other hosts, however, the spines approach the condition found in typical *suturalis*, the long setæ of the fourth tergite remaining as the only distinguishing character.

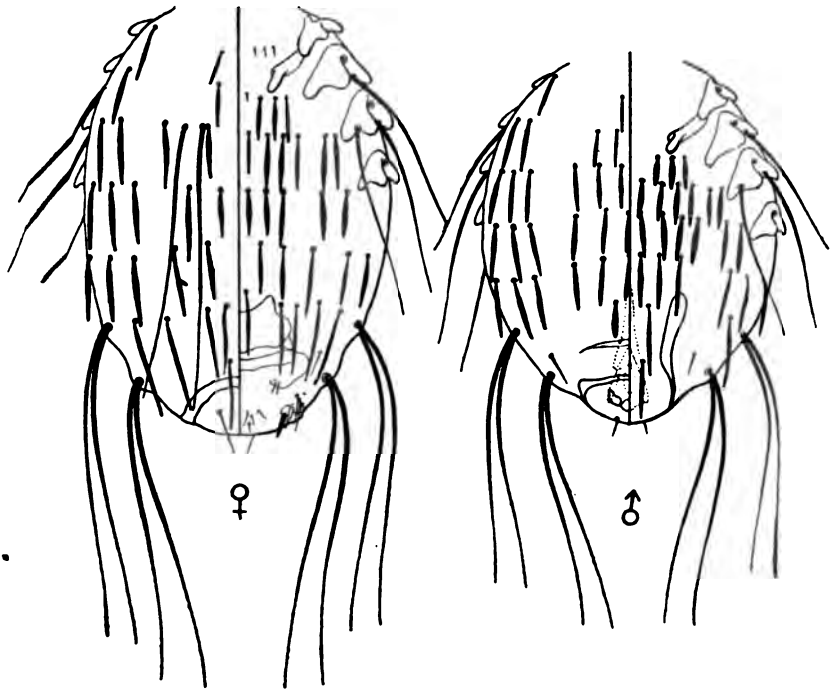

Fig. 29.—*Enderleinellus osborni* K. and F.: abdomen of male and female, from type specimens.

MALE (Fig. 29). Differing from the female in the absence of the long, slender setæ of the fourth tergite. In the typical form the male may be distinguished from the male of *suturalis* by the much fewer and stouter spines, but in other forms it is scarcely distinguishable.

NOTES.—It is possible that this form should not be distinguished as a species, but it is easily recognizable in the female sex.

Specimens from *Citellus beecheyi beecheyi* and *C. beecheyi fisheri* agree closely with the type. Those from *C. buckleyi* and *C. grammurus* and *Xerospermophilus tereticaudus* approach more closely *E. suturalis*, differing chiefly in the long setæ of the fourth tergite.

18. Enderleinellus marmotæ n. sp.

FIG. 30.

HOST OF THE TYPE. *Marmota monax rufescens*, Grafton, S. D. Holotype, a female.

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SPECIMENS EXAMINED. From *Marmota monax rufescens,* Grafton, S. D., and Elk River, Minn.; *Marmota monax monax,* Marble Cave, Mo.; Sandy Springs, Md., and Washington, D. C.

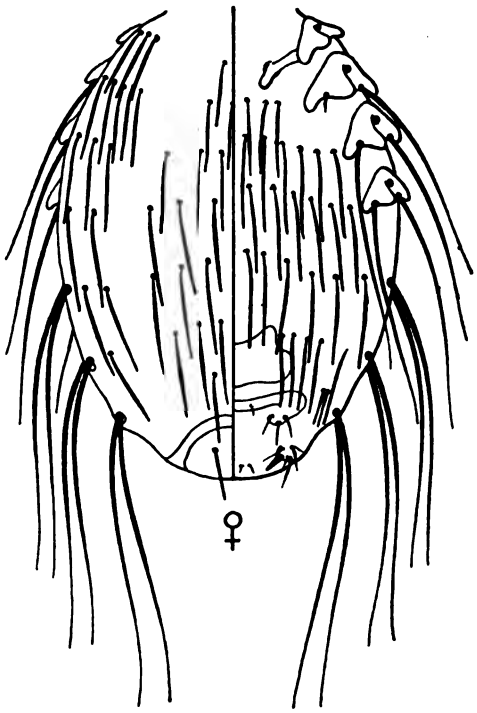

Fig. 30.—*Enderleinellus marmotae* n. sp.: abdomen of female.

MALE AND FEMALE. *Length* of the female .95 mm., length of the male 0.9 mm. Differing from *E. suturalis* and related forms constantly and chiefly in the presence of two long, slender setæ on the posterior margin of each pleural plate and at the lateral margins of the sixth, seventh, and eighth segments.

NOTES.—All the specimens at hand agree closely in the characters indicated above, and as the form is readily recognizable it may well be regarded as a distinct species.

19. Enderleinellus tamiasis Fahrenholz.

1916. *Enderleinellus tamiasis* Fahrenholz, *Archiv f. Naturges.,* Abt. A, **81**: 27, f. 22.

HOST OF THE TYPE. *Tamias striatus,* in the Zoological Garden in Berlin.

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NOTES.—I have not been able to obtain specimens of this species although I have examined numerous skins of its reputed host, which is a native of central United States and Canada. The original description is inadequate, there being no reference to the genitalia of the male, and the description is not accompanied by adequate figures.

Genus **MICROPHTHIRUS** new genus.

Anoplura without eyes; with five-segmented antennæ, which are not sexually dimorphic and which are beset with tooth-like processes; with the anterior and middle pairs of legs small and weak, with weak claw, the posterior pair very stout, with broad, heavy claw; pleural plates consisting merely of very small sclerites, the edges of which are not free; abdominal segments with not more than one transverse row of spines; tergites and sternites of the abdomen with well-defined plates; head more or less cylindrical, not widening abruptly behind the antennæ.

HOSTS. Known only from the genus *Sciuropterus* of the rodent family *Petauristidæ*, the flying squirrels.

TYPE OF THE GENUS. *Enderleinellus uncinatus* Ferris.

NOTES.—While the single species upon which this genus is based is certainly most closely related to the members of the genus *Enderleinellus*, it is so different in numerous respects as to render a separation advisable. The small first and second pairs of legs and the stout third pair with its broad claw and the cylindrical head connect the species with *Enderleinellus;* but the absence of free pleural plates, the absence of the paired sclerites on the second sternite, and the extraordinary antennæ are sufficient grounds for a separation.

1. **Microphthirus uncinatus** (Ferris).

FIGS. 31, 32.

1916. *Enderleinellus uncinatus* Ferris, Cat. Anoplura, *Proc. Cal. Acad. Sci.* (4), **6**: 149. (Without description.)

1916. *Enderleinellus uncinatus* Ferris; Ferris, *Psyche*, **23**: 108, figs. 6–7.

HOST OF THE TYPE. *Glaucomys* (= *Sciuropterus*) *sabrinus lascivus*, Yosemite National Park, California.

SPECIMENS EXAMINED. From type host and locality only.

FEMALE (Fig. 31). *Length* 0.45 mm. *Head* somewhat longer than broad, the anterior margin broadly rounded, the lateral margins, behind the antennæ, nearly parallel. Rostrum on the ventral side at a slight distance from the apex of the head. On the ventral side of the head there are between the bases of the antennæ two irregular chitinized areas. Behind each of these areas there is a smaller area, the posterior margin of which is deeply three-toothed. The antennæ (Fig. 32*B*) are of a very

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peculiar type, the first segment bearing on its ventral side a series of four stout teeth and the third and fourth segments with the anterior proximal angle likewise produced into a tooth.

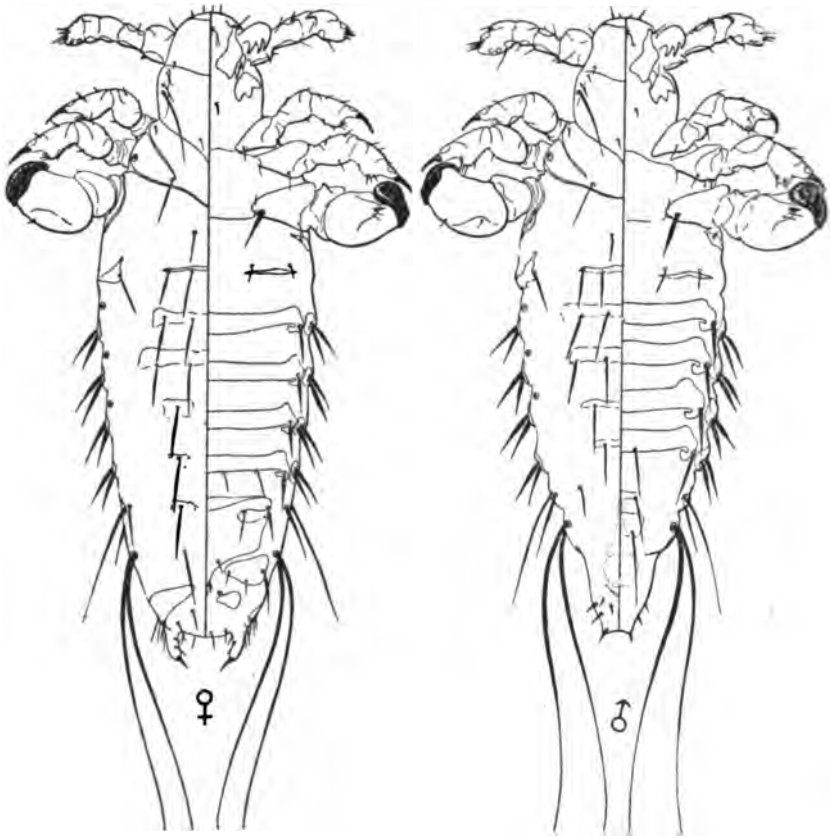

Fig. 31.—*Microphthirus uncinatus* (Ferris).

Thorax much shorter than the head, widest across its posterior margin, the division between the thorax and the abdomen scarcely indicated. Sternal plate very poorly defined but apparently quite broad, occupying the greater part of the venter of the thorax. Posterior femora each bearing a single small tooth-like process.

Abdomen elongate-oval, the apex rounded or narrowly truncate, terminated by a pair of lobe-like processes. Pleural plates present on the third to sixth segments, consisting merely of small, chitinized areas, the posterior margins of which are not free, each bearing a pair of stout, tapering, sharply pointed spines. The seventh segment bears at each lateral margin a single slender, moderately short seta and a spine. The

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eighth segment bears at each lateral margin a pair of long, slender setæ. Spines of the dorsum few, arranged in median groups of two to four on each segment. The tergites show a tendency toward a weak chitinization of their median portion.

On the ventral side the third to sixth segments each bear a narrow transverse sclerite which touches the pleural plates and bears at each end a stout, flattened spine. Genital plate occupying the greater part of the seventh and eighth segments.

MALE (Fig. 31). *Length* 0.35 mm. Resembling the female entirely except for its smaller size and for having the abdomen terminated by a broad, truncate process which bears several short, thorn-like spines.

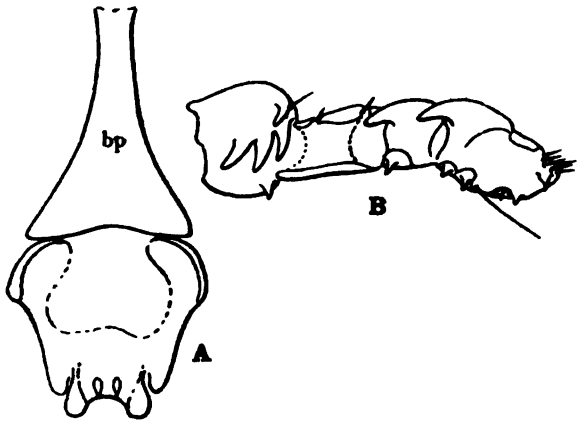

Fig. 32.—*Microphthirus uncinatus* (Ferris): *A*, genitalia of male; *B*, antenna.

Genitalia (Fig. 32*A*) very small and so highly modified as to preclude any definite conclusions as to the homologies of the parts. It is possible to recognize definitely only the basal plate (*bp*) to which is attached a broad, flattened piece, which possibly represents the fused parameres and other parts.

NOTES.—The measurements given above are from specimens which have been somewhat expanded in preparation and are consequently somewhat greater than those of the original description which were from untreated specimens. The length of the female in life is probably not more than 0.4 mm., and that of the male 0.35 mm.

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Contributions Toward a Monograph of the Sucking Lice

PART II.

BY
GORDON FLOYD FERRIS
Assistant Professor of Entomology

STANFORD UNIVERSITY, CALIFORNIA
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PREFATORY NOTE

Since the publication of Part I[1] of this series of papers the title of the publication in which it appeared has been altered. The former "Leland Stanford Junior University Publications, University Series," without volume or part numbers and with each part paged separately, has in part become "Stanford University Publications, University Series, Biological Sciences," with volume and part numbers. The papers included in this series of contributions will constitute Volume II of the Biological Sciences series, and Part I will stand as the first part of this volume. The parts will be consecutively paged and the figures consecutively numbered.

Except for certain slight changes in form, Part II is entirely continuous with Part I. In the list of specimens examined the origin of specimens taken by the author from skins in the United States National Museum and the Field Columbian Museum has been indicated by the abbreviations U. S. N. M. and F. C. M., followed by the museum numbers of the skins from which they were taken. I may add that paratypes of all species based upon specimens from the National Museum will be deposited in the collections of that institution.

[1] Part I is dated 1919, but was not issued officially until January 14, 1920.

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SYSTEMATIC TREATMENT (Cont.)

Genus **HOPLOPLEURA** Enderlein.

1904. *Hoplopleura*, Enderlein, *Zool. Anz.*, **28**: 221–223.
1908. *Hoplopleura*, Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.
1909. *Hæmatopinus* (*Polyplax*), Neumann, *Arch. de Parasit.*, **13**: 531.
1912. *Hoplopleura*, Fahrenholz, *2–3–4th Jahresb. des Niedersäch. Zool. Ver.*, pp. 44–46.
1915. *Hoplopleura*, Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.*, pp. 15–16.
1916. *Hoplopleura*, Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 153.

Anoplura without eyes; with five-segmented antennæ which are not sexually dimorphic; with the anterior legs small and weak and with weak, slender claw, the middle legs somewhat larger and with stouter claw, the posterior legs still larger, more or less flattened and with stout, blunt claw and usually with a tooth-like "olecranon process" at the outer proximal angle of the tibia; pleural plates always well developed, present on at least the first to seventh segments, the first pair always small and lying upon the dorsum; female usually with the third to seventh abdominal tergites and sternites bearing three transverse rows of setæ (and usually with a like number of chitinized plates), but occasionally with three rows of setæ on the third tergite and sternite only, the other segments with not more than two; male always with two rows of setæ on the third to seventh sternites, and the third tergite usually with but one row of setæ on the remaining tergites, but occasionally with two on the fourth to seventh; first plate of the third sternite in both sexes usually extending from pleurite to pleurite and usually with two pairs (or occasionally two groups of three) of conspicuously enlarged setæ; head usually with slight postantennal angles and without a constricted occipital region; genitalia of the males of a quite uniform type, the basal plate undivided, the parameres large and usually enclosing the pseudopenis.

Hosts. Occurring as far as known only on rodents of the families *Muridæ* (the rats and mice), *Sciuridæ* (the squirrels), *Petauristidæ* (the flying squirrels), and *Octodontidæ* (the coypus and tuco-tucos). The genus appears to be especially characteristic of the first two families named.

Type of the Genus. *Pediculus acanthopus* Burmeister.

Synonymical List of Names Previously Used in the Genus.

Note.—Names in italics are synonymns of the name with which they are coupled.

acanthopus (Burmeister).
Pediculus acanthopus Burmeister.

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Hæmatopinus acanthopus (Burmeister).
Polyplax acanthopus (Burmeister).
Hoplopleura acanthopus var. *americana* Kellogg and Ferris.
acanthopus var. *americana* Kellogg and Ferris.
Hoplopleura acanthopus (Burmeister).
affinis (Burmeister).
Pediculus affinis Burmeister.
Hæmatopinus affinis (Burm.).
Polyplax affinis (Burm.) (not of Fahrenholz).
arboricola Kellogg and Ferris, (part).
Hoplopleura erratica (Osborn).
arboricola Kellogg and Ferris, (part).
Hoplopleura erratica arboricola Kellogg and Ferris.
arboricola Kellogg and Ferris, (part).
Hoplopleura sciuricola n. sp.
bidentata (Neumann).
Hæmatopinus (*Polyplax*) *bidentatus* Neumann.
enormis Kellogg and Ferris.
erratica (Osborn).
Hæmatopinus erraticus Osborn.
Polyplax erratica (Osborn).
Hoplopleura arboricola Kellogg and Ferris, (part).
erratica arboricola Kellogg and Ferris.
Hoplopleura arboricola Kellogg and Ferris, (part).
hesperomydis (Osborn).
Hæmatopinus hesperomydis Osborn.
Polyplax hesperomydis (Osborn).
hirsuta Ferris.
hispida (Grube).
Pediculus hispidus Grube.
Pediculus gracilis Grube.
Hæmatopinus hispidus (Grube).
Polyplax hispida (Grube).
intermedia Kellogg and Ferris.
lineata Fahrenholz.
Hoplopleura longula (Neumann).
longula (Neumann).
Hæmatopinus (*Polyplax*) *longula* Neumann.
Hoplopleura lineata Fahrenholz.
maniculata (Neumann).
Hæmatopinus (*Polyplax*) *maniculata* Neumann.
neumanni Fahrenholz.
Hæmatopinus (*Polyplax*) *præcisus* Neumann, (part).
Hæmatopinus præcisus Neumann, (part).
Polyplax præcisa (Neumann), (part).
quadridentata (Neumann).
Hæmatopinus (*Polyplax*) *quadridentata* Neumann.
quadridentata (Neumann), (misidentification).
Hoplopleura nesoryzomydis n. sp.
trispinosa Kellogg and Ferris.

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NOTES.—In spite of the fact that this genus, as I have here limited it, seems, on the whole, to form quite a natural group, it is somewhat difficult to define, for of all the assemblage of characters that I have noted above but few are common to and peculiar to all the species of the genus, although there is a certain facies that is characteristic of the group.

The one really distinctive character that appears to occur in all the species of the genus and that I have not noted in any other forms is the position and form of the first pair of pleural plates, which are always developed and lie entirely upon the dorsum.

In the majority of the species the abdomen of the female bears three rows of setæ (and usually three transverse plates) upon the majority of the segments, both dorsally and ventrally. However, in at least two species that appear referable to this genus this arrangement is lost and the third segment alone appears to bear three rows of setæ, the remainder having not more than two. Furthermore, although this arrangement is characteristic of *Hoplopleura* it is not entirely peculiar to that genus. I have at hand two species that I consider to belong to *Neohæmatopinus* (if that genus be indeed distinct from *Polyplax*) in the females of which the abdominal tergites and sternites bear three rows of setæ, although all the other members of this group have but two rows on each segment.

The arrangement of the setæ and plates on the abdomen of the male is also characteristic, but is subject to certain modifications. Normally of the tergites the third alone possesses two rows of setæ, but in at least three species (one of which is the type of the genus) the third to seventh segments likewise have two rows. In all the species that I refer to the genus, the third to seventh sternites of the male have two rows of setæ.

I may note that a different interpretation may be given to the arrangement of the abdominal setæ. It is possible that in each case the second tergite, both in male and female, has two rows of setæ, rather than that the second has but one and the third two or three in accordance with the sex. Yet after careful consideration of this point I have been led to adopt the first interpretation.

The paired setæ of the third sternite are peculiar to the members of this genus, yet they are not always developed even in some species that are in all other respects typical of the group.

The legs are to some extent characteristic of the group, especially in the presence of the tooth-like "olecranon process" on the posterior tibiæ. In a few species, however, this process is not developed.

The genitalia of the males are of a more or less characteristic type and, compared with the genitalia in *Enderleinellus*, are extremely conservative. In but a few cases are they of any very marked value in aiding in the recognition of species. The basal plate is always undivided, and at its tip are set the parameres, which are usually slightly curved and nearly parallel, enclosing a weakly chitinized and somewhat U-shaped piece which I consider to represent the endomeres, within which is the penis. The pseudopenis usually lies between the tips of the parameres and consists of a pair of more or less curved and divergent arms which unite into a short shaft, the whole having a Y or V shape. The structures are so simple and the homologies so easily determinable that I have not lettered the parts in the figures.

The available material of the immature stages is not sufficient to permit a definite statement as to the number of instars. There are certainly three and possibly four. There appears to be a considerable variety of form in the earliest stages,

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and no generalizations are possible except to call attention to the apparently ge eral occurrence of small tubercles on the ventral side of the head and thorax. T antennæ and legs are in general of the same relative form as in the adult, the fc mer five-segmented, the posterior legs without the olecranon process.

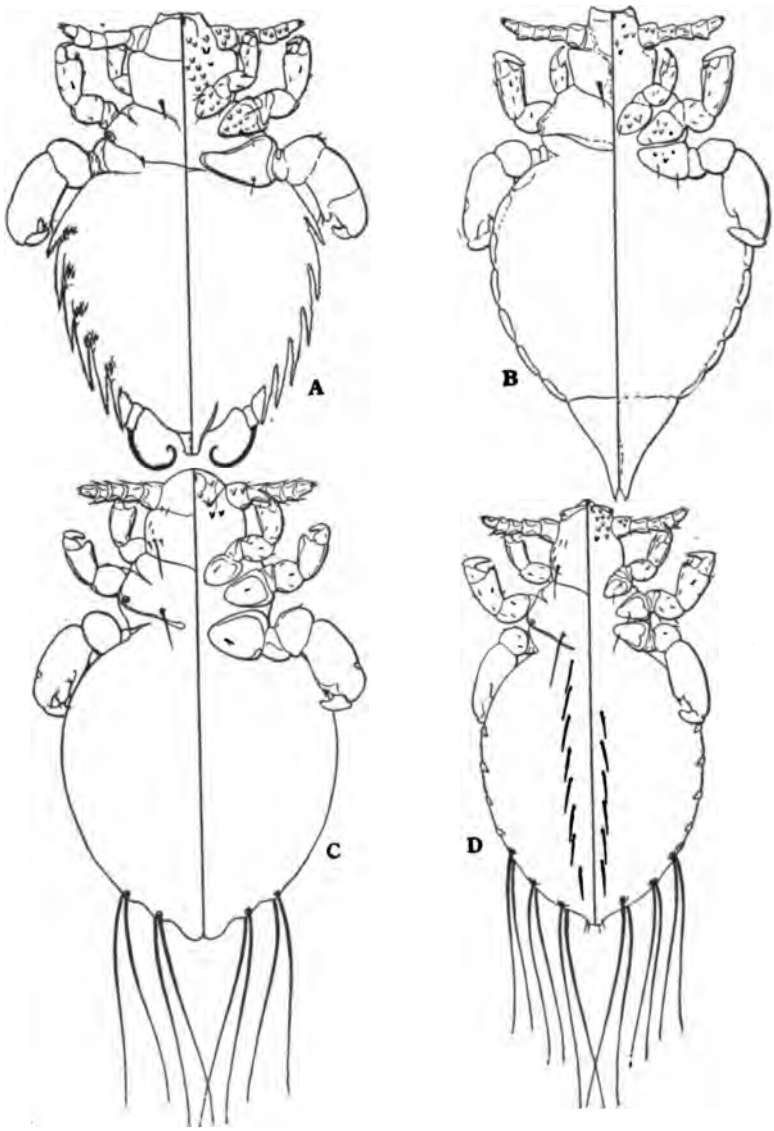

Fig. 33.—*A, Hoplopleura intermedia* K. and F., first (?) stage; *B, H. enormis pei mydis* n. sp., first (?) stage; *C, H. acanthopus* (Burm.), second (?) stag *D, H. erratica arboricola* K. and F., second(?) stage.

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In Figure 33 are shown the available immature stages of certain species. Figure 33*A* is of what appears to be the first stage of *H. intermedia* Kellogg and Ferris. Figure 33*B* is of what is probably the first stage of *H. enormis pelomydis* n. sp. Figure 33*C* is the probable second stage of *H. acanthopus* (Burm.). One specimen of this form was found still within the derm of the preceding stage, the latter differing in having but the posterior pair of long setæ on the abdomen. Figure 33*D* is of the apparent second stage of *H. erratica arboricola* Kellogg and Ferris, this, too, having been found within the derm of an earlier stage, from which it differs only in the presence of the rudimentary pleural plates. There are at hand, also, immature stages of *H. hirsuta Ferris*, which are similar to this, except that three segments of the abdomen are provided with long setæ. Within one of these specimens appears a fully formed adult male.

The genus, as I here understand it, might possibly be divided, such forms as *H. audax* n. sp. and *H. alata* n. sp., for instance, presenting characters upon which a separation might easily be made. Yet I am not inclined to any such step. The group here included (with the possible exclusion of *H. disgrega* n. sp.) constitutes almost an ideal expression of my present conception of a genus. There are listed in this paper 41 forms, of which 25 are here described as new. Two of the forms that are listed are in all probability synonyms, but as I have not seen specimens from their type hosts I retain the names. Excepting only these two and one other, representatives of all the included forms have been available for examination.

1. Hoplopleura acanthopus (Burm.)

(Synonymy under subspecies.)

1a. Hoplopleura acanthopus acanthopus (Burm.).

FIGS. 34, 35.

1839. *Pediculus acanthopus* Burmeister, "Rhynchota," *Gen. Ins.*, No. 5, pl. 1, f. 2.
1842. *Hæmatopinus acanthopus* (Burm.), Denny, "Mon. Anopl. Brit.," p. 25, pl. 24, f. 3.
1864. *Pediculus acanthopus* Burm., Nitzsch, *Zeits f. ges. Naturw.*, **23**: 27.
1874. *Hæmatopinus acanthopus* (Burm.), Giebel, "Insecta Epizoa," pp. 36–37, pl. 2, f. 3.
1880. *Hæmatopinus acanthopus* (Burm.), Piaget, "Les Pediculines," pp. 638–640, pl. 52, f. 4.
1891. *Hæmatopinus acanthopus* (Burm.), Osborn, *U. S. Dept. Agric., Div. Ent.*, Bul. 7, o. s.: 23, f. 11.
1896. *Hæmatopinus acanthopus* (Burm.), Osborn, *ibid.*, Bul. 5, n. s.: 181–182, f. 104.
1904. *Polyplax acanthopus* (Burm.), Enderlein, *Zool. Anz.*, **28**: 142.
1904. *Hoplopleura acanthopus* (Burm.), Enderlein, *ibid.*, **28**: 220–223, f. 1–2.
1908. *Hoplopleura acanthopus* (Burm.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.
1910. *Hoplopleura acanthopus* (Burm), Mjöberg, *Ark. f. Zool.*, **6**: 164.
1912. *Hoplopleura acanthopus* (Burm.), Fahrenholz, *2–3–4th Jahresb. des Niedersäch. Zool Ver.*, pp. 46–52, tf. 18–20; pl. 2, f. 14–15.
1915. *Hoplopleura acanthopus* var. *americanus* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.*, p. 16, tf. 3; pl. 4, f. 2; pl. 5, f. 8.
1916. *Hoplopleura acanthopus* (Burm.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 153.

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1916. *Hoplopleura acanthopus* var. *americanus* Kellogg and Ferris, Ferris, *Ibid.*, **6**: 154.

PREVIOUS RECORDS. Type from *Microtus* (=*Arvicola*) *arvalis*, Europe. Recorded from this host by various writers (Nitzsch, Giebel, Fahrenholz); from *Microtus* (=*Hypudæus*=*Arvicola*) *agrestis*, England and continental Europe (Denny, Enderlein, Mjöberg); *Microtus*

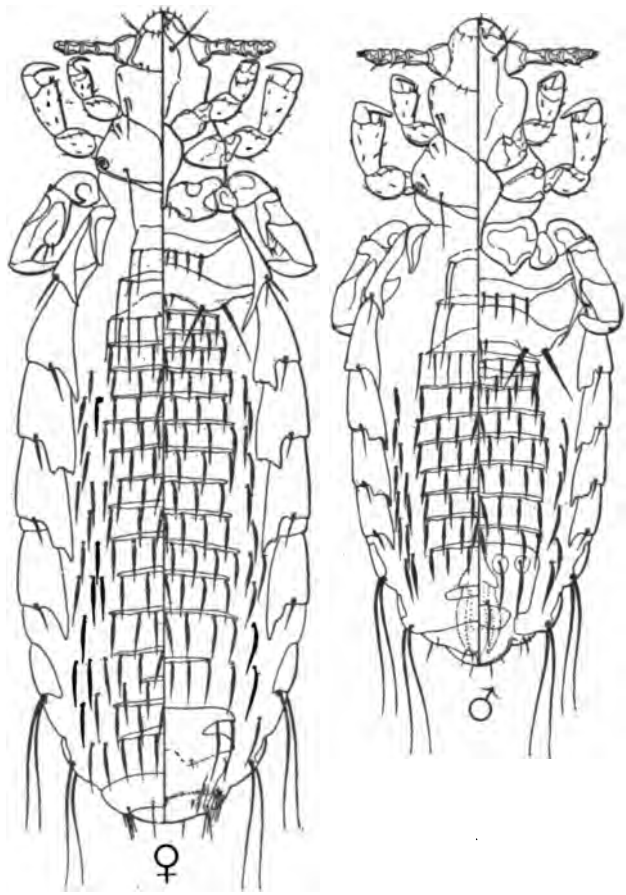

Fig. 34. *Hoplopleura acanthopus* (Burm.), female from *Microtus californicus*, male from *Microtus agrestis*.

(=*Arvicola*) *nivalis*, Europe (Fahrenholz); *Dicrostonyx* (=*Lemmus*) *torquatus*, Europe (Mjöberg); *Mus musculus*, Europe (Piaget, Mjöberg); *Microtus* (=*Arvicola*) sp., Ames, Iowa, U. S. A. (Osborn); *Microtus constrictus*, Mendocino City, *M. californicus*, Covelo, and *Microtus* sp., South Yolla Bolly Mountain, California, U. S. A. (Kellogg

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and Ferris); "white lemming," Pt. Barrow, Alaska (?) (Kellogg and Ferris).

SPECIMENS EXAMINED. The specimens upon which the above records by Kellogg and Ferris are based and the following: Europe, *Microtus agrestis,* Jemtland, Sweden (U. S. N. M. 105752); *Microtus nivalis,* Chamonix, France (U. S. N. M. 124482); *Mus musculus,* Rumania (U. S. N. M. 105244); *Mus spicilegus,* Upsala, Sweden (U. S. N. M. 85056). North America, *Evotomys nivarius,* Happy Lake, Wash. (F. C. M. 6247); *Lemmus alascensis,* Pt. Barrow, Alaska (U. S. N. M. 107733); *Neotoma cinerea,* Yosemite National Park, California (probably straggler); *Pity-*

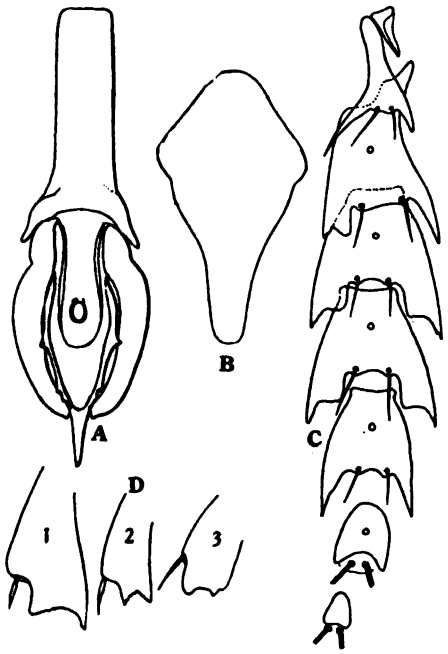

FIG. 35.—*Hoplopleura acanthopus* (Burm.): *A,* genitalia of male from *Microtus agrestis; B,* sternal plate of female from the same host; *C,* pleural plates of female from *Microtus californicus; D,* copies of Fahrenholz' figures of (1) *H. acanthopus acanthopus,* from *Microtus arvalis,* (2) *H. acanthopus æquidentis,* (3) *H. acanthopus edentulus.*

mys pinetorum, New York (U. S. N. M. 88733), and Council Bluffs, Iowa (U. S. N. M. 31888); *Synaptomys* sp., Athabasca Landing, Canada (U. S. N. M. 129396); "mouse," Lafayette, Ind., and Florence, Mont.

All of the hosts belong to the family *Muridæ* and all to the subfamily *Microtinæ,* except the genus *Mus,* which belongs to the *Murinæ,* and the genus *Neotoma,* which belongs to the *Neotominæ.*

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FEMALE (Fig. 34). Length 1.2–1.4 mm. *Head* narrowly rounded in front, with moderately prominent post-antennal angles and with a narrow, elongate, chitinized area on the ventral side between the bases of the antennæ. *Thorax* and legs of ordinary form; sternal plate (Fig. 35*B*) elongate, tapering and bluntly pointed posteriorly.

Pleural plates (Fig. 35*C*) as follows: First pair of ordinary form; second pair with a short tooth at the dorsal angle and a long tapering process at the ventral angle; third with a long, tapering tooth at the dorsal angle and with a broad ventral lobe, the tooth and the lobe separated by a broad interspace; fourth and fifth each with the angles produced into a short tooth, the posterior margin divided into two broad lobes by a deep, broad incision; sixth with the dorsal and ventral angles each produced into a long, tapering tooth; seventh and eighth small and without teeth; second to sixth each with a pair of short setæ on the posterior margin, the seventh and eighth with the usual pairs of long setæ.

Tergites and sternites of the abdomen with the normal number of rows of setæ and plates, the latter narrow, of variable lengths, the longest occupying about half the width of the abdomen. Tergal plates for the most part with five to seven setæ. Fourth to eighth segments with one to three setæ between the ends of each plate and the pleurites. Sternal plates with six to eight setæ, the fourth to seventh segments with one to two setæ between the ends of each plate and the pleurites. Paired setæ of the third sternite long and slender.

MALE (Fig. 34). Length 0.9–1.1 mm. *Pleural plates* essentially as in the female but with the lobes and teeth slightly shorter.

Tergites of the third to seventh segments with two rows of setæ and two plates. Eighth segment with one plate and no setæ. Plates for the most part with six to seven setæ of uniform length and the fourth to seventh segments with one or two setæ between the ends of each plate and the tergites. *Sternites* with the normal arrangement of plates and setæ, the setæ essentially as on the dorsum.

Genitalia (Fig. 35*A*) with the basal plate rather short, not greatly longer than the parameres, the pseudopenis with the arms long and slender.

NOTES.—I have not seen specimens from the typical host, but as the many specimens available from numerous closely related host species show extremely little variation there is no reason to doubt the correctness of their identification. Kellogg and Ferris have previously separated specimens on American hosts as the variety *americanus*, but this is quite untenable.

It is extremely probable that *Pediculus hispidus* Grube, from *Lemmus obensis*, is a synonym of *H. acanthopus*. This species is unquestionably a *Hoplopleura*, and *H. acanthopus* occurs upon other species of *Lemmus*. However, in the absence of specimens from this host I have not reduced the species.

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H. acanthopus is a very distinctive form, recognizable by the form of the pleural plates and the presence of two tergal plates on the majority of the abdominal segments of the male.

1b. Hoplopleura acanthopus aequidentis Fahr.

FIG. 35*D*2.

1916. *Hoplopleura acanthopus* var. *æquidentis* Fahrenholz, *Archiv. f. Naturges.*, Abt., A, **81**: 26, f. 21*b*. (August.)

1916. *Hoplopleura acanthopus æquidentis* Fahrenholz, *Zool. Anz.*, **48**: 92. (October.)

PREVIOUS RECORDS. Type from *Pitymys* (= *Arvicola*) *subterraneus*, "bei Neustadt (Siebenbürgen)." The host is distributed throughout Europe. It is a member of the subfamily *Microtinæ* of the family *Muridæ*.

NOTES.—I have not seen specimens of this form. According to Fahrenholz, "Zur Charakterisierung genügt es, die Ventralfortsätze der Pleurite des 3. Abdominal segments zu vergleichen. Wie Fig. (35*D*1) zeigt, hat *Hoplop. acanth* ♀ (von *Arvicola arvalis*) an dem betreffenden Pleurit zwei zahnartige Fortsätze, von denen der äuszere stumpf und der innere spitz und länger ist; var. *aequidentis* (Fig. 35*D*2) tragt zwei spitze, die unter sich gleich sind."

Figure 35*D* is a copy of the figure given by Fahrenholz. Unless there are other differences than those indicated by Fahrenholz, this form seems scarcely to merit recognition as distinct from *H. acanthopus*.

1c. Hoplopleura acanthopus edentulus Fahr.

FIG. 35*D*3.

1916. *Hoplopleura acanthopus* var. *edentulus* Fahrenholz, *Archiv. f. Naturges.*, Abt. A., **81**: 26, f. 21*c*. (August.)

1916. *Hoplopleura acanthopus edentulus* Fahrenholz, *Zool. Anz.*, **48**: 93. (October.)

PREVIOUS RECORDS. Type from *Evotomys* (= *Mus*) *rutilus*, "aus Siebenbürgen, Kronstadt." The host is a native of northern Europe and Asia and is a member of the subfamily *Microtinæ* of the family *Muridæ*.

NOTES.—I have not seen specimens of this form. According to Fahrenholz, "Das fragliche Pleurit (the third) hat hier nur zwei unbedeutende Höcker (Fig. 35*D*3); . . . Entsprechende Abänderung zeigen auch die Fortsätze der übrigen Pleurite; . . ."

Figure 35*D*3 is a copy of the figure given by Fahrenholz. If the statement that the remaining pleurites show characters similar to the third be correct it would certainly seem that this form is a distinct species.

2. Hoplopleura hispida (Grube).

1851. *Pediculus hispidus* Grube, Middendorff's Reise, Zool., p. 497, pl. 2, f. 2 (figure labeled *P. gracilis*).

1874. *Hæmatopinus hispidus* (Grube), Giebel, "Insecta Epizoa," p. 38.

1880. *Hæmatopinus hispidus* (Grube), Piaget, "Les Pediculines," p. 640.

1904. *Polyplax hispida* (Grube), Enderlein, *Zool. Anz.*, **28**: 142.

1908. *Polyplax hispida* (Grube), Dalla Torre, "Anoplura," *Gen Ins.*, p. 13.

1916. *Hoplopleura hispida* (Grube), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 156.

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PREVIOUS RECORDS. Known only from the original record by Grube, who recorded specimens from *Lemmus obensis,* "am Taimyrsee," Siberia. The host belongs to the subfamily *Microtinæ* of the family *Muridæ.*

NOTES.—I have not seen specimens from this host, but the original description and figure are sufficiently good to show that the species is unquestionably a *Hoplopleura.* In view of the fact that *H. acanthopus* (Burm.) occurs upon other species of *Lemmus,* there is every reason to believe that the species from *L. obensis* is *H. acanthopus.* In the absence of specimens, however, I have not reduced the species.

3. Hoplopleura longula (Neum.)

FIGS. 36, 37.

1909. *Hæmatopinus* (*Polyplax*) *longulus* Neumann, *Arch. de Parasit.,* **13**: 513–515, f. 15–17.
1910. *Hoplopleura lineata* Fahrenholz, *Zool Anz.,* **35**: 715.
1915. *Hoplopleura* (*?*) *longula* (Neum.), Kellogg and Ferris, *Ann. Durban Mus.,* **1**: 155.
1916. *Hoplopleura longula* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad Sci.* (4), **6**: 156.

PREVIOUS RECORDS. Type from *Micromys* (= *Mus*) *minutus,* Colchester, Essex, England. Also recorded by Fahrenholz (as *H. lineata*) from the same host without indication of locality. The host belongs to the subfamily *Murinæ* of the family *Muridæ.*

SPECIMENS EXAMINED. A male and a female from the type lot, received through the kindness of Professor G. H. F. Nuttall, and one female from *Micromys minutus,* Brunswick, Germany (U. S. N. M. 85374).

FEMALE (Fig. 36). Length 1.1 mm. *Head* rather short, rounded or narrowly truncate in front, with moderately prominent postantennal angles and with a broad, chitinized area on the ventral side between the antennæ. *Thorax* and legs of ordinary form, the sternal plate (Fig. 37*C*) elongate, slender, tapering and bluntly pointed posteriorly.

Pleural plates (Fig. 37*A*) strongly scaly or reticulate; first pair of ordinary form; second with a short dorsal tooth and a long, tapering ventral process; third, fourth, and fifth with the angles produced into a short tooth and with the posterior portion divided into two equal lobes by a deep and quite narrow incision in the posterior margin; sixth likewise divided into lobes, but these unequal, the ventral lobe tapering and pointed; seventh and eighth without lobes; second with a pair of short setæ on the posterior margin, third with a single stout seta at the base of the incision; seventh and eighth each with the usual pair of slender setæ, remainder without setæ.

Tergites and sternites of the abdomen with the usual number of rows of setæ and with the plates well developed, of more or less uniform length, occupying slightly more than half the width of the segment. Each tergal

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plate with from four to seven quite large tapering setæ. Sternal plates with from seven to eight setæ, those occupying the median area noticeably smaller than the others. Fifth to seventh sternites with a single seta between the ends of one or two of the plates and the pleurites. All of the setæ appear as if divided by slight diagonal constrictions into two parts (Fig. 37*B*), an appearance that is found in other species but is especially marked in this. Paired setæ of the third sternite quite long and slender.

Fig. 36.—*Hoplopleura longula* (Neum.), female from Brunswick, Germany, male from the type lot.

Male (Fig. 36). Length 1 mm. *Pleural* plates as in the female. *Tergites* of all the abdominal segments except the third with one plate, the third with two. Eighth tergite without setæ, the remainder with four to seven, those of the fourth to seventh segments quite large. *Sternites* with

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from six to eight setæ, all smaller than those of the dorsum, those of the median area tending to be noticeably smaller than the others.

Genitalia of the single available male distorted and not in condition for description, apparently presenting no especially distinctive characters.

NOTES.—There is, I believe, no question that *Hoplopleura lineata* Fahr. is identical with *H. longula* (Neum.). The species is one of a series of forms occurring on various *Muridæ*, all very similar and differing chiefly in the details of the pleural plates, the form of the sternal plate, and, to a slight degree, the arrangement

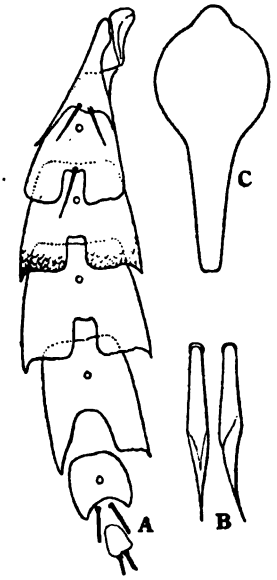

Fig. 37.—*Hoplopleura longula* (Neum.): *A*, pleural plates of female from Brunswick, Germany; *B*, abdominal setæ of same; *C*, sternal plate of same.

of the setæ on the abdomen. The broad lobes of the third pair of pleural plates, the tapering ventral lobe of the sixth pair and the absence of lobes on the seventh and eighth pairs, together with the peculiarly marked abdominal setæ, may be considered to distinguish this species from *H. hesperomydis*, *H. affinis*, and other very similar forms.

4. Hoplopleura hesperomydis (Osborn).

FIGS. 38, 39.

1891. *Hæmatopinus hesperomydis* Osborn, *U. S. Dept. Agric., Div. Ent.*, Bul. 7, o. s.: 26, f. 14.

1896. *Hæmatopinus hesperomydis* Osborn, *U. S. Dept. Agric., Div. Ent.*, Bul. 5, n. s.: 184–185, f. 108.

1904. *Polyplax (?) hesperomydis* (Osborn), Enderlein, *Zool. Anz.*, **28**: 143.

1908. *Polyplax (?) hesperomydis* (Osborn), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.

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1915. *Hoplopleura hesperomydis* (Osborn), Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.*, p. 17, tf. 4–5; pl. 4, f. 1; pl. 5, f. 14.

1916. *Hoplopleura hesperomydis* (Osborn), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 155.

1916. *Hoplopleura hesperomydis* (Osborn), Ferris, *Psyche*, **23**: 112.

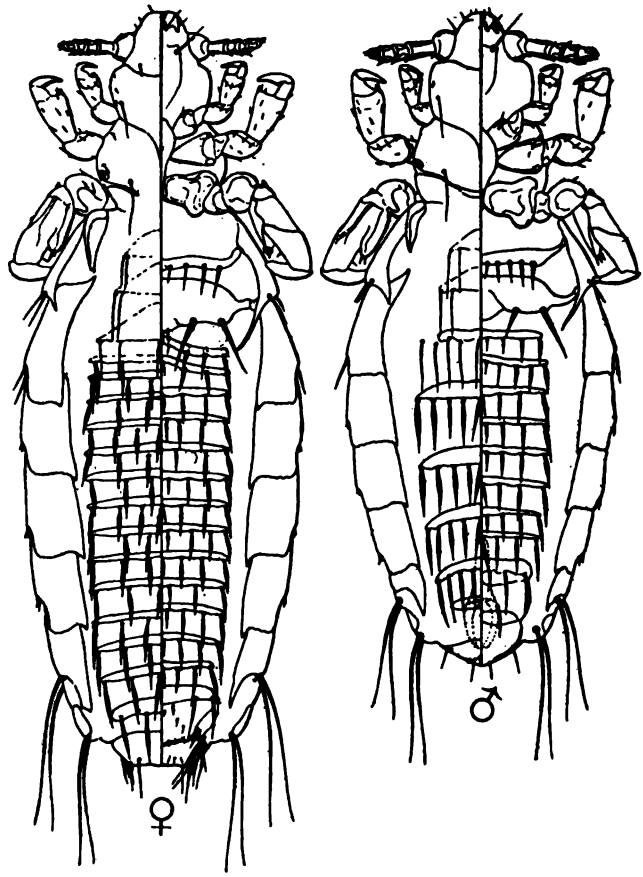

Fig. 38.—*Hoplopleura hesperomydis* (Osb.), male and female from *Peromyscus leucopus noveboracensis*, Piedmont, Mo.

Previous Records. Type from *Peromyscus* (=*Hesperomys*) *leucopus*, Ames, Iowa, U. S. A. Recorded by Ferris and Kellogg and Ferris. from various subspecies of *Peromyscus maniculatus* and *P. boylei* in California, and by Ferris from *Onychomys torridus pulcher*, Victorville, Cal., *O. leucogaster arcticeps*, Colorado Springs, Colo., and *Mus musculus*, Stanford University, Cal.

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SPECIMENS EXAMINED. All of those upon which the preceding records by Ferris and Kellogg and Ferris are based and the following: *Eligmodontia collisæ,* Goya, Argentina (U. S. N. M. 94164); *Mus musculus,* Dzharkent, Russian Turkestan (U. S. N. M. 155467), and West Falls Church, Va., U. S. A.; *Mus gansus,* Taochou, Kansu, China (F. C. M. 19073); *Mus wagneri mongolium,* Tai-yuan-fu, Shensi, China (U. S. N. M. 172503); *Onychomys torridus longicaudus,* Independence, Cal.; *Oryzomys chaparensis,* Todos Santos, Bolivia (F. C. M.); *Oryzomys fulvescens,* Orizaba, Vera Cruz, Mexico (U. S. N. M. 58259).

All of the hosts are *Muridæ,* the members of the genus *Mus* belonging to the subfamily *Murinae,* the remainder to the *Cricetinae.*

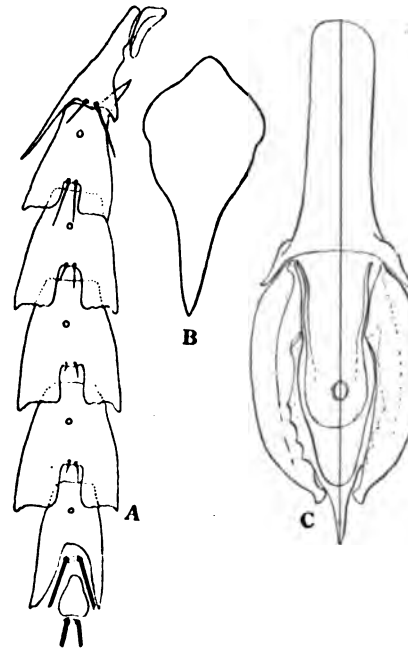

Fig. 39.—*Hoplopleura hesperomydis* (Osb.): *A,* pleural plates of the female from *Peromyscus leucopus noveboracensis; B,* sternal plate of same; *C,* genitalia of male from same host.

FEMALE (Fig. 38). Length 1 mm. *Head* narrowly rounded in front of the antennæ, the post-antennal angles moderately prominent, the ventral side with a median, shield-shaped, chitinized area. *Thorax* and legs of normal form, the sternal plate (Fig. 39*B*) elongate, tapering and acutely pointed posteriorly.

Pleural plates (Fig. 39*A*) as follows: First pair of normal form; second with a short dorsal tooth and a long, tapering ventral process;

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third to sixth each divided into two equal lobes by a deep and quite narrow incision in the posterior margin and with the posterior angles produced into slight teeth; seventh likewise divided into two lobes, but with these narrow and tapering; eighth without teeth or lobes; second to sixth each with two setæ at the base of the incision, these very small except on the second and third; seventh and eighth with the usual pair of slender setæ; all the plates presenting a more or less scaly appearance.

Tergal and sternal plates of the abdomen well developed and of nearly uniform width, occupying slightly more than half the width of the abdomen. Each tergal plate with from four to seven quite stout setæ. Sternal plates with from six to eight setæ, these slightly smaller than those of the dorsum and with those of the median area tending to be slightly smaller than the others. Typically there are no setæ between the ends of any of the plates and the pleurites, either dorsally or ventrally. Paired setæ of the third sternite long and slender.

Male (Fig. 38). *Length* 0.6 mm. *Pleural plates* as in the female except that the lobes of the seventh pair are scarcely longer than the body of the plate. *Tergal plates* presenting the normal arrangement, the third segment with two, the remainder with one. Tergal plate of the eighth segment without setæ, the remainder with from four to nine, these for the most part quite stout. *Sternal plates* with from six to nine setæ, these much smaller than those of the dorsum and those of the median area smaller than the others.

Genitalia (Fig. 39*C*) presenting no especially distinctive characters; pseudopenis with the arms much longer than the shaft and not greatly curved.

Notes.—In many respects this species is very similar to *H. longula* (Neum.), but it is distinguishable by the equal lobes of the sixth pleurite and the slender lobes of the seventh. All the specimens that I refer to it agree quite closely except those from *Onychomys*, in which the setæ are all noticeably slender and the posterior margins of the pleural plates extremely serrate. The specimens from the various species of *Mus* are inseparable from those from *Peromyscus*, in spite of the apparent anomaly in their distribution.

5. Hoplopleura angulata n. sp.

Figs. 40, 41.

Specimens Examined. Type from *Rhipidomys venezuelæ*, Venezuela (*F. C. M.* 7048). Holotype a female. Also from *Rhipidomys* sp., Rio San Miguel, Peru (U. S. N. M. 194500); *R. venustus*, Merida, Venezuela (U. S. N. M. 137507); and *Thomasomys cinereus*, Balsas, Peru (F. C. M. 19824). All the hosts are Murids of the subfamily *Cricetinæ*.

Female (Fig. 40). *Length* 1.4 mm. *Head* (Fig. 41*C*) narrowly rounded in front and with acute, projecting post-antennal angles. *Thorax*

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and legs of normal form; sternal plate (Fig. 41*E*) wedge-shaped, acute posteriorly.

Pleural plates (Fig. 41*A*) strongly scaly or reticulate; first pair of normal form; second pair with a short dorsal tooth and a longer, tapering, ventral tooth; third to sixth divided into two lobes, of which the ventral is slightly the narrower, by a deep incision in the posterior margin, this somewhat narrower than the lobes; seventh with a slight tooth at each angle; eighth small and without teeth; second and third each with a pair of small setæ; fourth to sixth each with a small seta at the base of the incision; seventh and eighth with the usual pair of long setæ.

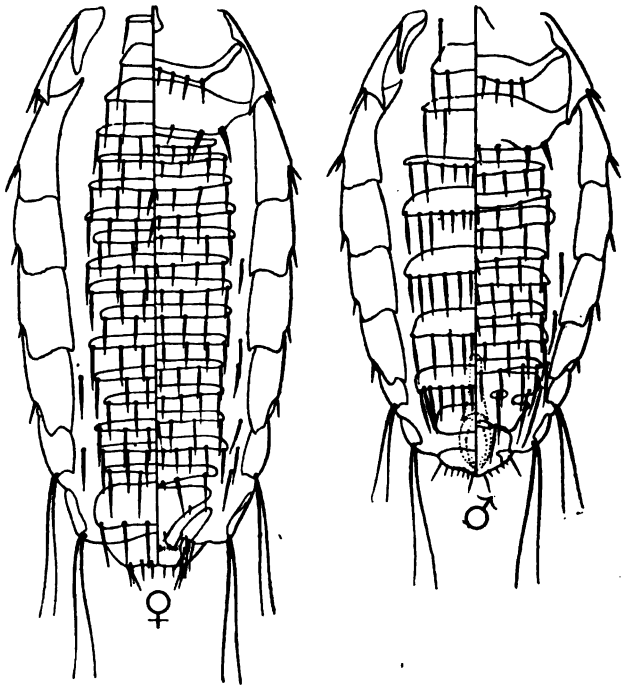

Fig. 40.—*Hoplopleura angulata* n. sp.: abdomens of male and female.

Tergal and sternal plates strongly developed, of the normal number and arrangement, the widest occupying something more than half the width of the abdomen. Tergal plates with from four to seven rather small and slender setæ. Sternal plates with seven to eight setæ, these somewhat smaller than those of the dorsum. Paired spines of the third sternite stout, rather short, and slightly curved.

MALE (Fig. 40). *Length* 1.1 mm. *Pleural plates* as in the female. *Tergal plates* strongly developed, the third segment with two, the remain-

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der with but one, these, except for the eighth, with as many as fourteen slender setæ. *Sternal plates* narrower than the tergal plates, arranged as usual, with from eight to ten slender setæ.

Genitalia (Fig. 41*B*) with the arms of the pseudopenis strongly curved, not serrate externally.

NOTES.—This species is in general quite close to *H. hesperomydis* but is marked chiefly by the absence of processes on the seventh pair of pleural plates. In typical

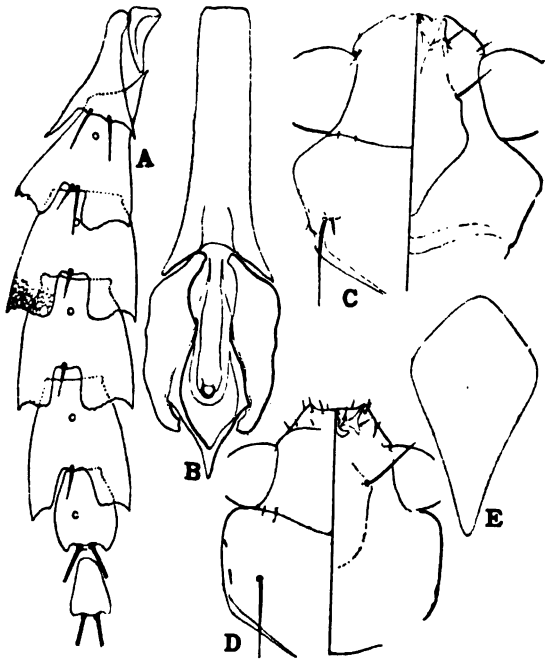

Fig. 41.—*Hoplopleura angulata* n. sp.: *A*, pleural plates of female; *B*, genitalia of male; *C*, head; *E*, sternal plate. *Hoplopleura hesperomydis* (Osb.); *D*, head of typical example.

specimens the angular head is likewise quite distinctive (compare Figs. 41*C* and 41*D*), but in those from *Thomasomys* this character is not so marked. There are likewise minor, but possibly not important, differences in the size of the tergal and sternal plates and of the setæ.

6. Hoplopleura affinis (Burm.).

FIGS. 42, 43.

1839. *Pediculus affinis* Burmeister, "Genera Insectorum, Rhynchota," p. 10.
1842. *Hæmatopinus affinis* (Burm.), Denny, "Mon. Anopl. Brit.," p. 36.
1864. *Pediculus affinis* Burm., Nitzsch, *Zeit. f. ges. Naturw.*, **23**: 22.
1874. *Hæmatopinus affinis* (Burm.), Giebel, "Insecta Epizoa," p. 39, pl. 1, f. 9.

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1880. *Hæmatopinus acanthopus* var. *affinis* (Burm.), Piaget, "Les Pediculines," p. 639.
1904. *Polyplax affinis* (Burm.), Enderlein, *Zool. Anz.*, **28**: 142.
1908. *Polyplax affinis* (Burm.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 13.
1916. *Polyplax affinis* (Burm.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 172, (part).

Previous Records. From *Apodemus* (= *Mus*) *agrarius* and *A. sylvaticus*, Europe. Type host not designated.

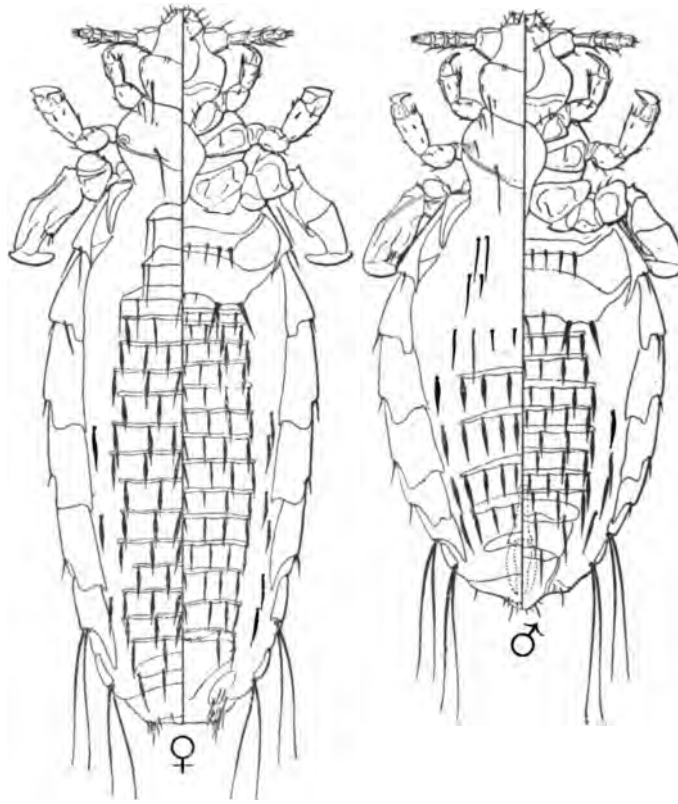

Fig. 42. *Hoplopleura affinis* (Burm.): female from *Apodemus sylvatica tscherga*, Altai, Siberia; male from *A. agrarius agrarius*, Dresden, Germany.

Specimens Examined. From *Apodemus agrarius agrarius*, Dresden, Germany (U. S. N. M. 120955); *A. agrarius mantchuricus*, Sungaree River, Manchuria (U. S. N. M. 197805); and *A. sylvaticus tscherga*, Altai, Siberia (U. S. N. M. 175174); *Rattus nigricaudus loringii*, Naivasha Station, British East Africa (U. S. N. M. 162539); *Cricetulus incanus*, Shensi, China (U. S. N. M. 172550); *Akodon arenicola*, La Plata, Argentina (U. S. N. M. 94161); *A. arviculoides montensis*, Sapucay,

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Paraguay (U. S. N. M. 121380) and Chubut, Valle del Lago Blanco, Argentina (F. C. M. 18891); *A. aurosus,* Chunchumayo, Peru (U. S. N. M. 148841); *A. cursor,* Piquette, São Paulo, Brazil (F. C. M. 18182); *A. mollis,* Molinopampas, Peru (U. S. N. M. 181334); *Euneomys* sp., La Raya Pass, Peru (U. S. N. M. 194544); *Phyllotis domorum,* Parotani, Bolivia (F. C. M.); *P. micropus,* Rio Chico, Patagonia (U. S. N. M. 84290); *P. pictus,* Junin, Peru (F. C. M. 21140); *Reithrodon hatcheri,* Cordilleras, Patagonia (U. S. N. M. 54199).

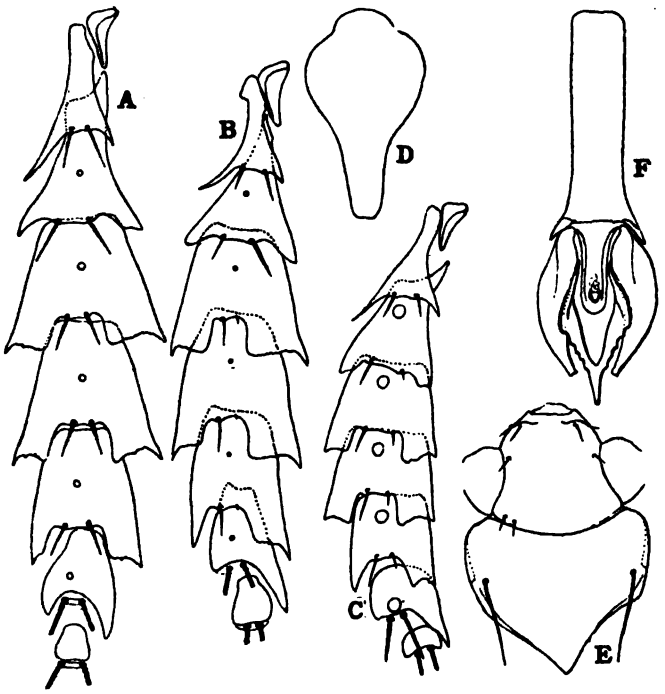

Fig. 43. *Hoplopleura affinis* (Burm.): *A,* pleural plates of female from *Cricetulus incanus,* Shensi, China; *B,* pleural plates of female from *Euneomys* sp., La Raya Pass, Peru; *C,* pleural plates of male from *Apodemus agrarius agrarius,* Dresden, Germany; *D,* sternal plate of female from same host as *C; E,* head of female from same host as *C; E,* genitalia of male from same host as *C.*

All of the hosts belong to the family *Muridæ,* the genera *Apodemus* and *Rattus* to the subfamily *Murinæ,* the remainder to the *Cricetinae.*

Female (Fig. 42). Length 1.1 mm. *Head* (Fig. 43*E*) narrowly rounded in front of the antennæ, with slight post-antennal angles, the posterior lateral margins curved and converging slightly posteriorly, the ventral side with a narrow, chitinized area between the antennæ. *Thorax*

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and legs of normal form; sternal plate (Fig. 43*D*) roughly circular, with the posterior portion narrowly produced, tapering and with truncate apex.

Pleural plates (Fig. 43*C*) strongly developed, overlapping, presenting a somewhat scaly appearance; first pair of ordinary form; second with a short dorsal tooth and a longer, tapering ventral process; third with a short, narrow, truncate or pointed lobe at each posterior angle; fourth and fifth each with a broad lobe at each angle, the ventral lobe slightly the narrower, and between them a somewhat broader interspace; seventh with a similar dorsal lobe and with a tapering ventral tooth; eighth without teeth; second to sixth each with a pair of small setæ on the posterior margin, the ventral setæ the larger; seventh and eighth with the usual pairs of long setæ.

Tergal and sternal plates of the abdomen well developed, arranged in the usual manner. Tergal plates with from four to six quite stout, tapering setæ, the first plate of the fifth to seventh segments with a single seta between each end and the pleurite. Sternal plates with seven to eight setæ, these all smaller than the dorsal setæ and with those of the median area noticeably smaller than the others. Paired setæ of the third sternite quite long and slender.

MALE (Fig. 42). *Length* 0.95 mm. *Pleural Plates* as in the female. *Tergal and sternal plates* well developed except on the first three tergites. Third tergite with two rows of setæ, remainder with one or none. Setæ for the most part quite large and stout, each segment, except the eighth, with from four to eight along the plate, the fourth to seventh with one seta on each side between the end of the plate and the pleurite. Sternal plates arranged as usual, with practically the same number of setæ as on the dorsum but these smaller, those of the median area distinctly smaller than the others.

Genitalia (Fig. 43*F*) presenting no especially distinctive characters, the pseudopenis with the arms quite strongly angular and serrate.

NOTES.—The identification of this species with the *Pediculus affinis* of Burmeister will doubtless be questioned and requires an explanation.

Two species of Anoplura, one a *Polyplax*, the other a *Hoplopleura*, occur on the genus *Apodemus*. Superficially the members of these two genera are very similar and if taken together would probably not have been separated by the earlier authors. The original description of *Pediculus affinis* (as quoted by Denny) is as follows: "Pallidus, sincipite parabolico genis post antennas incrassatis; thorace rhombeo." I am unable to see in this description anything that can throw much light on the identity of the species in question.

The description given by Giebel is equally inadequate, but his figure is unmistakably a *Hoplopleura*, as is evidenced by the form of the head. Fahrenholz, however, has recently identified the species of *Polyplax* occurring on *Apodemus* as *affinis*.

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Perhaps the name should be discarded, but if it is to be accepted at all it is probably better to use it as understood by the earliest author who figured or described the species in a recognizable manner, and if this be done the name will stand for the species recorded by Giebel and not for that recorded by Fahrenholz. The disposition of the latter species will be considered in connection with the genus *Polyplax*.

Males alone are available from *Apodemus agrarius agrarius*, and it is upon these that the description and figures of the male given above are based. These agree very closely with the males from *Apodemus sylvatica tscherga*, and the description and figures of the female are based upon the specimens from the latter host.

The specimens from *Cricetulus incanus* agree quite closely in the form of the pleural plates (Fig. 43*A*) with the typical examples, but the spiracles are noticeably smaller and the setæ much more slender and somewhat more numerous.

The specimens from the various South American hosts are for the most part similar in the form of the pleural plates (Fig. 43*B*), but the spiracles are smaller, the sternal plate is more angular, and in the majority of the specimens the setæ are more numerous and much more slender, although the examples from *Phyllotis micropus* differ but little in this respect from typical examples. The specimens from *Reithrodon hatcheri* lack the lobe on the seventh segment but in other respects are similar.

It is possible that I have been unduly conservative in referring all the above specimens to a single species, yet it seems certain that all are very closely related, and the differences separating the various forms are after all quite small. Speculation, on the basis of mounted specimens alone, as to whether they may not constitute subspecies is futile. The species as a whole is distinguishable from its nearest relatives, *H. hesperomydis*, *H. longula*, *H. malaysiana*, by the narrow and widely separated lobes of the third pleurite, the tapering, slender, ventral lobe of the sixth pleurite and the usually present, tapering dorsal lobe of the seventh.

7. Hoplopleura malaysiana n. sp.

FIGS. 44, 45.

SPECIMENS EXAMINED. From *Rattus vociferans lancavensis*, Langkavi Island, Malay Straits (U. S. N. M.). Holotype a female. The host belongs to the subfamily *Murinæ* of the family *Muridae*.

FEMALE (Fig. 44). *Length* 1mm. *Head* rather short and broad, truncate anteriorly, with moderately prominent post-antennal angles and with a broad, chitinized area on the ventral side between the antennæ. *Thorax* and legs of ordinary character; sternal plate (Fig. 45*B*) short and broad.

Pleural plates (Fig. 45*A*) not at all or but weakly scaly, the spiracles moderately large; first pair of plates of ordinary form; second with a short dorsal tooth and a longer, tapering ventral tooth; third to sixth each divided into two truncate lobes, the ventral lobe much narrower than the dorsal, that of the sixth pair tapering and pointed; seventh and eighth

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pairs without lobes or teeth; second to sixth each with a pair of small setæ, the seventh and eighth with the usual slender setæ.

Tergal and sternal plates well developed, occupying a little more than half the width of the abdomen, arranged as usual. Tergal plates for the most part with four to eight rather slender setæ. Sternal plates with about the same number of setæ, but these smaller than those of the dorsum.

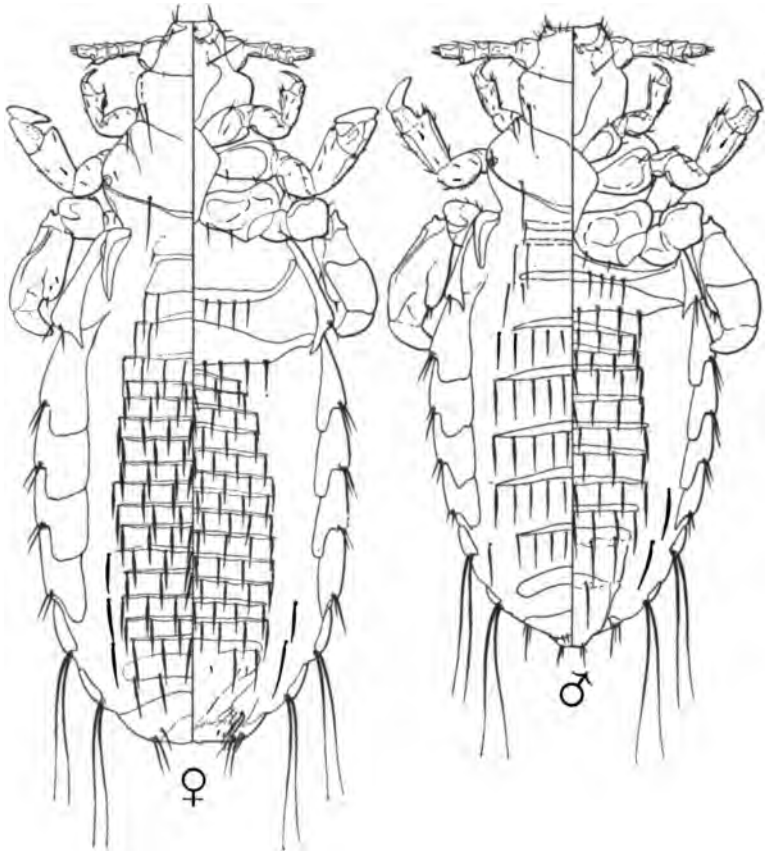

Fig. 44.—*Hoplopleura malaysiana* n. sp., male and female.

Paired setæ of the third sternite weakly developed, not borne on prominences.

MALE (Fig. 44). *Length* 0.9 mm. *Pleural plates* as in the female. *Tergal and sternal plates* arranged in the usual manner, the former with for the most part eight to ten slender setæ, the latter with six to seven. *Genitalia* (Fig. 45*C*) with no especially distinctive characters.

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NOTES.—This species is somewhat of the type of *H. longula* and *H. affinis*. It is distinguishable by the narrow ventral lobes of the pleural plates and the weak development of the paired setæ of the third sternite.

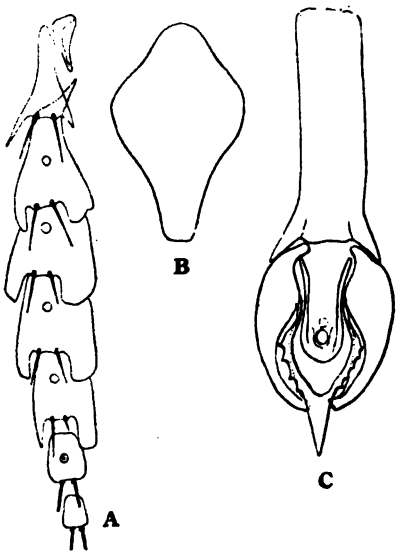

Fig. 45.—*Hoplopleura malaysiana* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

8. Hoplopleura chrotomydis n. sp.

FIG. 46.

SPECIMENS EXAMINED. From *Chrotomys whiteheadi*, Irisan, Benguet, Philippine Islands (U. S. N. M.). Holotype a female. The host is a Murid of the subfamily *Hydromyinæ*.

FEMALE. In general form and appearance closely resembling the preceding, *H. malaysiana*. Differing chiefly in the form of the pleural plates (Fig. 46*A*), the dorsal lobe being narrower and more or less truncate, the ventral lobe in each case slender, tapering and pointed. *Sternal plate* (Fig. 46*B*) slightly more angular than in *malaysiana*. *Tergal and sternal plates* with for the most part six to nine setæ, these all quite slender. Paired setæ of the third sternite well developed, borne on slight prominences.

MALE. *Pleural plates* as in the female but with the dorsal lobe pointed and tapering. *Tergal and sternal plates* arranged as usual, the tergal plates for the most part with eight to nine slender setæ, the sternal plates with from five to seven, these slightly stouter than those of the dorsum. *Genitalia* (Fig. 46*C*) with the arms of the pseudopenis long, diverging but little.

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NOTE.—In general this species approaches quite closely *H. malaysiana* but is readily distinguishable by the form of the pleural plates, the tapering, ventral lobe of the third to sixth plates being quite distinctive.

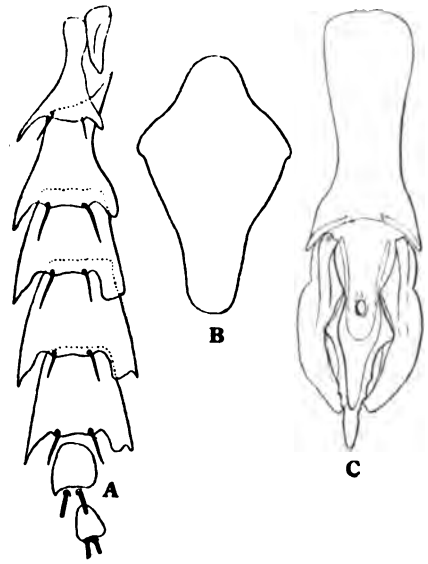

Fig. 46. *Hoplopleura chrotomydis* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

9. Hoplopleura oenomydis n. sp.

FIGS. 47, 48.

SPECIMENS EXAMINED. Types from *Oenomys hypoxanthus bacchante*, Molo, British East Africa (F. C. M. 17090). Holotype a female. Also from *Dasymys incomptus helukus*, Nairobi, British East Africa (F. C. M. 17046), (a single specimen, perhaps a straggler); *Thamnomys surdaster polionopus*, Sukenya Mountain, British East Africa (F. C. M. 17133); *Limnomys mearnsi*, Grand Malindang, Mindanao, Philippine Islands (U. S. N. M. 144621); *Rattus calcis*, Baguio, Luzon, Philippine Islands (U. S. N. M. 145778). The hosts are Murids.

FEMALE (Fig. 47). *Length* 1.5 mm. *Head* rather slender and relatively small, narrowly rounded in front of the antennæ and with slight post-antennal angles and with the lateral margins of the hind head curved and somewhat convergent. *Thorax* and legs of ordinary form; sternal plate (Fig. 48*B*) elongate, tapering and blunt posteriorly.

Pleural plates (Fig. 48*A*) slightly or not at all scaly, the spiracles moderately large; first pair of plates of normal form; second pair with a short dorsal and longer ventral tooth; third to sixth pairs divided into two lobes by a deep and rather broad incision, the ventral lobe in each

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case considerably smaller than the dorsal lobe, on the sixth pair being merely a tapering tooth; seventh and eighth pairs without lobes; second pair with a pair of small setæ, third to sixth each with a single small seta, seventh and eighth with the usual pairs of slender setæ.

Tergal and sternal plates distinctly developed, arranged as usual. Tergal plates with for the most part six to seven rather slender setæ, ster-

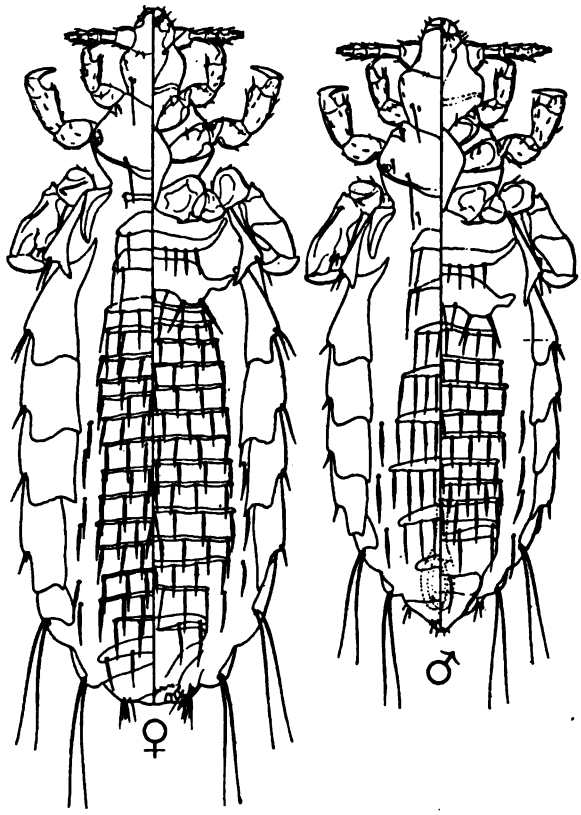

Fig. 47.—*Hoplopleura œnomydis* n. sp., male and female from *Œnomys hypoxanthus bacchante*.

nal plates with seven to eight, these slightly smaller than those of the dorsum. Paired setæ of the third sternite well developed, slender, set on slight prominences.

Male (Fig. 47). *Length* 0.95 mm. *Pleural plates* in general as in the female, but with the ventral lobes narrower. *Tergal and sternal plates* normally arranged, the tergal plates with for the most part six to eight slender setæ, the sternal plates with seven or eight. *Genitalia* (Fig. 48*C*) with no especially distinctive characters.

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NOTES.—This species is one of the *affinis-hesperomydis* group, distinguishable chiefly by the broad dorsal and narrower ventral lobe of the third pair of pleural plates, the tapering ventral lobe of the sixth pair and the absence of lobes on the

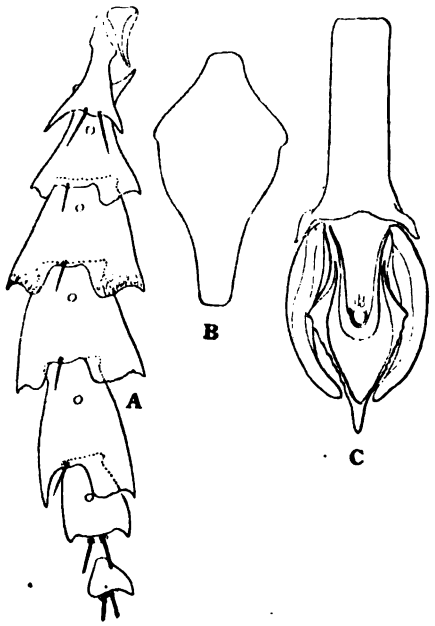

Fig. 48.—*Hoplopleura œnomydis* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male. All figures from specimens from *Œnomys hypoxanthus bacchante*.

seventh and eighth pairs. In the types the head is noticeably slender, but this character is not especially marked in the specimens from the other hosts. It is possible that the specimens from the Philippine hosts should not be referred to this species, but I am unable to find any very definite characters upon which to separate them.

10. Hoplopleura apomydis n. sp.

FIGS. 49, 50.

SPECIMENS EXAMINED. From *Apomys bardus*, Malindang Peak, Mindanao, Philippine Islands (U. S. N. M. 144592). Holotype a female. The host is a Murid.

FEMALE (Fig. 49). *Length* 1.1 mm. *Head* rather short and broad, with slight post-antennal angles. *Thorax* and legs of normal form; sternal plate rounded, produced posteriorly.

Pleural plates (Fig. 50*A*) slightly scaly, spiracles moderately large; first pair of plates of ordinary form; second pair with a short dorsal and a slightly longer ventral tooth; third to sixth pairs divided into two lobes

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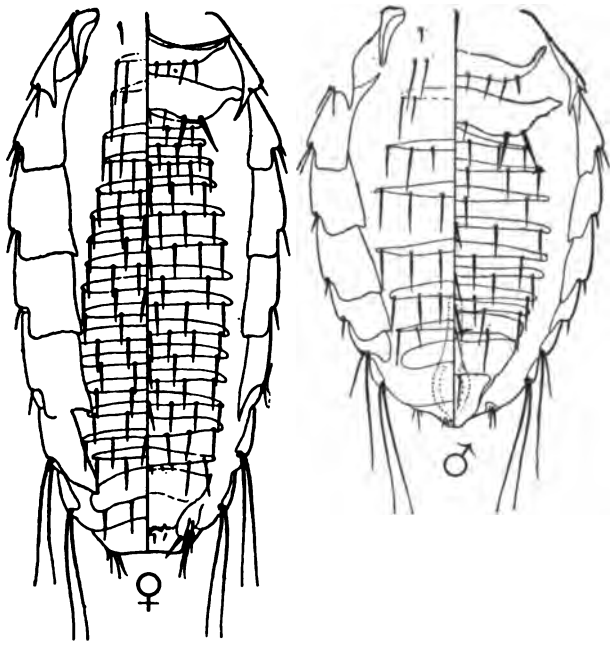

Fig. 49.—*Hoplopleura apomydis* n. sp., abdomens of male and female.

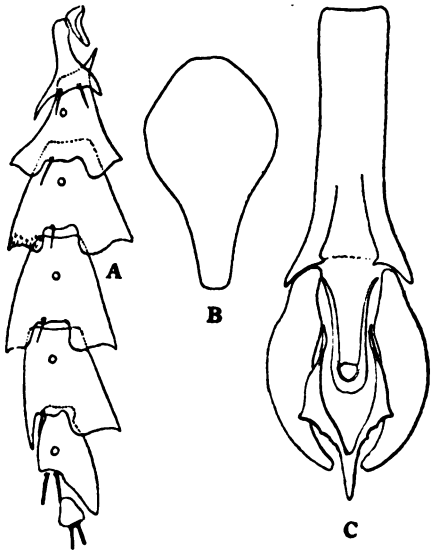

Fig. 50.—*Hoplopleura apomydis* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

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by a deep and rather broad incision, the ventral lobes slightly narrower than the dorsal, except on the sixth pair, where the ventral lobe is a tapering tooth; seventh with a broad, tapering dorsal lobe; eighth without lobes; second with two small setæ, third to sixth with one small seta, seventh and eighth with the usual pairs of slender setæ.

Tergal and sternal plates arranged as usual, but unusually large. Tergal plates with from four to six small, slender setæ. Sternal plates for the most part with six to seven similar setæ. Paired setæ of the third sternite slender, set on slight prominences.

MALE (Fig. 49). *Length* 0.75 mm. *Pleural plates* in general as in the female, but with the ventral lobes narrower, all more or less tapering. *Tergal and sternal plates* arranged as usual with for the most part four to six small, slender setæ. *Genitalia* (Fig. 50*C*) with no especially distinctive characters.

NOTES.—This species is another of the *affinis-hesperomydis* group, characterized by the broad dorsal and ventral lobes of the third pair of pleural plates, the tapering ventral lobe of the sixth pair and the broad, tapering dorsal lobe of the seventh pair, the unusually large tergal and sternal plates, and the smallness and paucity of the dorsal and ventral setæ.

11. **Hoplopleura sukenyae** n. sp.

FIG. 51.

SPECIMENS EXAMINED. A single female from *Mus triton*, Mt. Sukenya, British East Africa (F. C. M. 16769). The host belongs to the subfamily *Murinæ* of the *Muridæ*.

FEMALE (Fig. 51) *Length* 1.2 mm. *Head* narrowly rounded or slightly truncate in front, with slight post-antennal angles. *Thorax* and legs of ordinary form; sternal plate (Fig. 51*B*) almost quadrangular, slightly produced anteriorly and with a short, almost parallel-sided process posteriorly.

Pleural plates (Fig. 51*C*) strongly scaly; first pair of ordinary form; second with a small, lobe-like process at each posterior angle; third to seventh each divided into two lobes by a deep, narrow incision in the posterior margin, the lobes of the third pair rounded, those of the fourth and fifth with the internal angles rounded and the external angles slightly pointed, those of the sixth and seventh narrow and rounded; eighth without lobes; second to sixth each with a pair of small setæ at the base of the incision; seventh and eighth with the usual slender setæ.

Tergal and sternal plates arranged as usual, strongly developed, extending almost across the abdomen. Tergal plates with for the most part four to six small, stout, acute setæ. Sternal plates with for the most part

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seven to eight small, slender setæ. Paired setæ of the third sternite rather small, not borne on prominences.

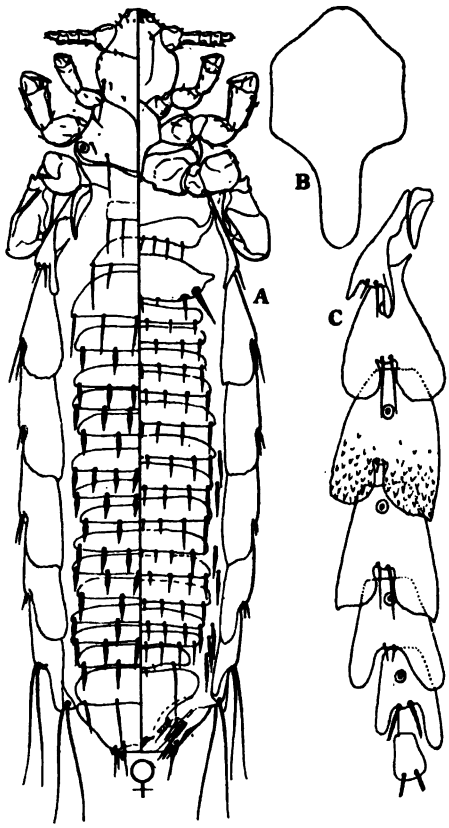

Fig. 51.—*Hoplopleura sukenyæ* n. sp.: *A*, female; *B*, sternal plate; *C*, pleural plates.

NOTE.—This is a member of the *affinis-hesperomydis* group, the pleural plates resembling most closely those of the latter species but marked by the peculiarly shaped lobes.

12. Hoplopleura quadridentata (Neum.).

FIGS. 52, 53.

1909. *Hæmatopinus* (*Polyplax*) *quadridentatus* Neumann, *Arch. de Parasit.*, **13**: 5; 3–15, f. 13, 14.

1915. *Hoplopleura* (*?*) *quadridentatus* (Neum.), Kellogg and Ferris, *Ann. Durban Mus.*, **1**: 155.

1916. *Hoplopleura quadridentatus* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 156, (part).

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PREVIOUS RECORDS. Recorded by Neumann from *Nectomys* (= *Holochilus*) *squamipes*, "Haut Peru." Later erroneously recorded by Ferris from *Nesoryzomys narboroughi* from the Galapagos Islands.

SPECIMENS EXAMINED. From *Nectomys squamipes*, Sapucay, Paraguay (F. C. M. 18162), and *N. palmipes*, Princetown, Island of Trinidad (F. C. M. 4908); *Oryzomys fulvescens*, Orizaba, Vera Cruz, Mexico (U.

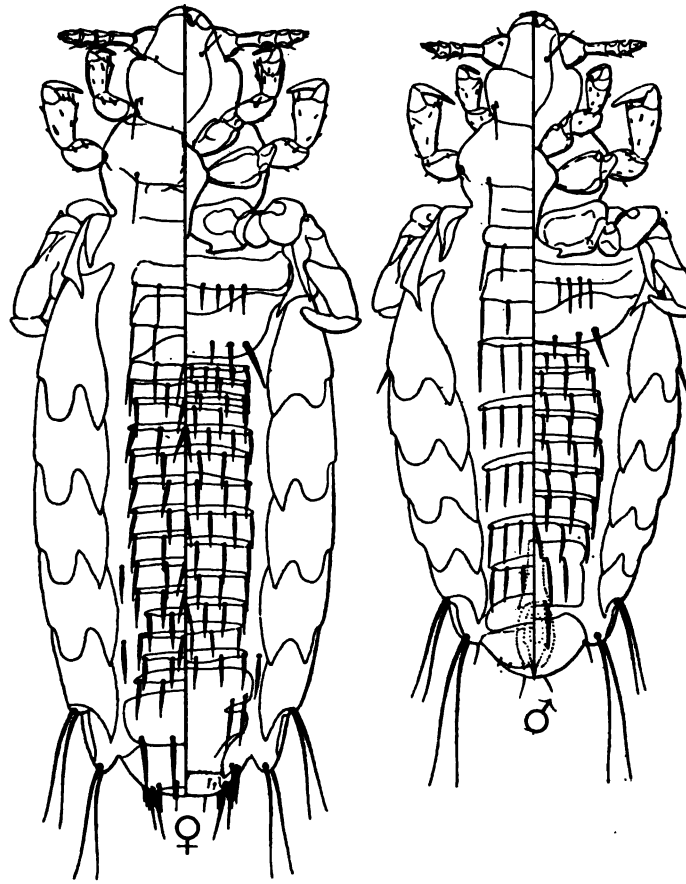

Fig. 52.—*Hoplopleura quadridentata* (Neum.), male and female from *Nectomys squamipes*.

S. N. M. 58259); and *O. rostratus*, Alta Mira, Tamaulipas, Mexico (U. S. N. M. 92935). All the hosts are Murids of the subfamily *Cricetinæ*.

FEMALE (Fig. 52). *Length* 1.25 mm. *Head* narrowly rounded in front of the antennæ, with rather prominent post-antennal angles and with a broad, chitinized area on the ventral side between the antennæ. *Thorax*

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and legs of normal form; sternal plate (Fig. 53*C*) elongate, tapering posteriorly.

Pleural plates (Fig. 53*B*) large, overlapping and presenting a markedly scaly or reticulate appearance; first pair of normal form; second with short dorsal and ventral teeth; third to sixth with the posterior margin divided into four prominent lobes of nearly equal size, the outer lobes somewhat acute, the median lobes rounded; seventh with two quite long, tapering lobes, the dorsal lobe with a small lobule on the inner margin;

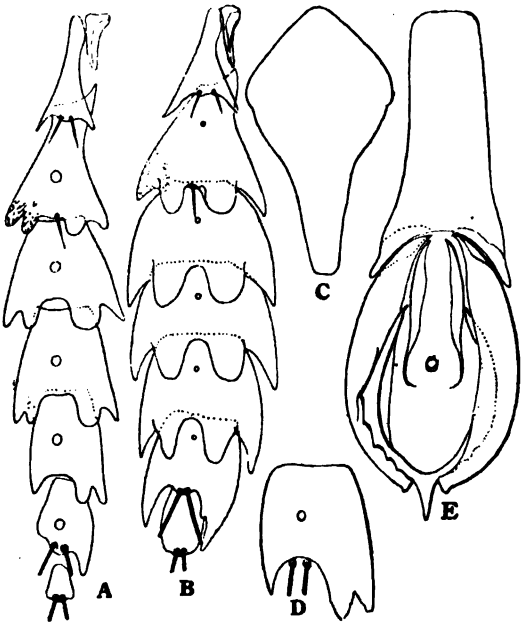

Fig. 53.—*Hoplopleura quadridentata* (Neum.): *B*, pleural plate of female; *C*, sternal plate; *E*, genitalia of male. From specimens from *Nectomys palmipes*; *D*, sixth pleural plate of specimen from *Oryzomys rostratus*. *Hoplopleura nesoryzomydis* n. sp.: *A*, pleural plates of female, paratype.

eighth without lobes; second with two setæ, third with one, the remainder with none except for the usual pairs on the seventh and eighth.

Tergal and sternal plates well developed, but occupying scarcely half the width of the abdomen, arranged as usual, the tergal plates for the most part with four to five rather stout setæ, the sternal plates for the most part with six or seven setæ. Paired setæ of the third sternite rather weakly developed, not borne on prominences.

Male (Fig. 51). *Length* 0.95 mm. *Pleural plates* in general as in the female, but with the lobes somewhat less prominent. *Tergal and sternal plates* arranged as usual, with for the most part six rather slender

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setæ. *Genitalia* (Fig. 52*E*) with the basal plate scarcely longer than the parameres and with arms of the pseudopenis strongly curved.

NOTES.—Having at hand specimens from the host species from which the types of this species were taken the determination may be regarded as quite definite. In the light of these specimens it appears that the species previously recorded by me as *H. quadridentata* from *Nesoryzomys narboroughi* must be considered as distinct, *H. quadridentata* is a quite well-defined form that may be regarded as a rather near relative of *H. hesperomydis,* from which it is distinguishable by the deeply lobed pleural plates. It is also very similar, at least superficially, to *H. isomydis* n. sp., an African form. The latter differs, however, especially in having the head strongly angular behind the antennæ.

The specimens from the two species of *Oryzomys* differ somewhat from those from *Nectomys,* those from *O. fulvescens* lacking the ventral lobe of the seventh pleural plate and those from *O. rostratus* having the dorsal lobe of this plate (Fig. 53D) broader than in the typical specimens and distinctly two-toothed. I am, however, not disposed to recognize these as distinct forms.

13. Hoplopleura nesoryzomydis n. sp.

FIG. 53*A*.

1916. *Hoplopleura quadridentata* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 156, (part).

1916. *Hoplopleura quadridentata* (Neum.), Ferris, *Psyche,* **23**: 116, f. 9*b*, 11*c*, 12. (Misidentification.)

PREVIOUS RECORDS. Recorded by Ferris as *H. quadridentata* (Neum.) from *Nesoryzomys narboroughi,* and *N. defessus,* Galapagos Islands.

SPECIMENS EXAMINED. As recorded above, the types from *Nesosyzomys narborough* (holotype a female) and the following: *Oryzomys angouya,* Sapucay, Paraguay (F. C. M. 18167), and *O. xantheolus,* Menocucho, Peru (F. C. M. 19431); *Zygodontomys seorsus,* San Miguel Id., Panama (U. S. N. M. 116671). The hosts are Murids of the subfamily *Cricetinæ.*

MALE AND FEMALE. In all respects closely resembling *H. quadridentata* except in the following details: *Pleural plates* (Fig. 53*A*) with but one ventral lobe on the sixth segment, without the ventral lobe on the seventh and with the lobes on all the plates less well defined.

NOTES.—It is possible that this form should not be recognized as anything more than a subspecies of *H. quadridentata,* but it is quite well marked and maintains its characters over a rather wide host and territorial range.

14. Hoplopleura intermedia Kellogg and Ferris.

FIGS. 54, 55*B-C-D*, 56*B*.

1915. *Hoplopleura intermedia* Kellogg and Ferris, *Ann. Durban Mus.,* **1**: 153, pl. 16, f. 5–5*d*.

1916. *Hoplopleura intermedia* K. and F., Ferris, *Ibid.,* **1**: 243, tf. 27.

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1916. *Hoplopleura intermedia* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 156.

PREVIOUS RECORDS. From *Rattus* (= *Mus*) *coucha,* Mfongosi, Zululand, South Africa.

SPECIMENS EXAMINED. As recorded above and from the following: *Dendromys mesomelas insignis,* Kaimosi, British East Africa (U. S. N. M. 184091); *Rattus tullbergi peromyscus,* Molo (F. C. M. 17025) and

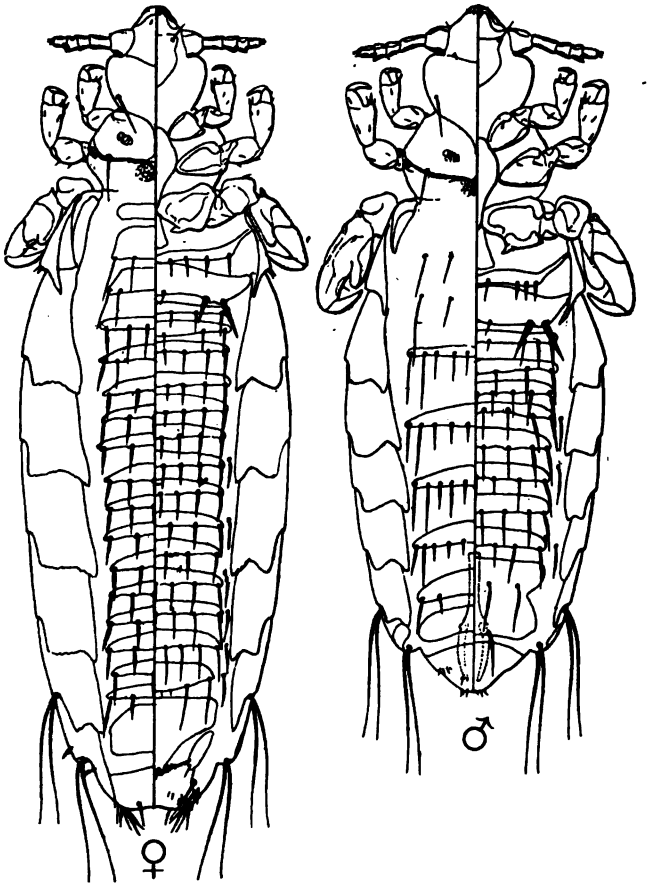

Fig. 54. *Hoplopleura intermedia* Kellogg and Ferris, male and female, from paratypes.

Guas Naishu Plateau, British East Africa (U. S. N. M. 163353); *Zelotomys hildegardæ,* Mt. Sukenya, British East Africa (F. C. M. 16955). The hosts are Murids belonging to the subfamily *Murinæ,* except the genus *Dendromus,* which belongs to the *Dendromyinæ.*

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FEMALE (Fig. 54). *Length* 1.2 mm. General form elongate and slender. *Head* (Fig. 56*B*) quite short and broad, narrowly truncate in front, with prominent, rounded, post-antennal angles. *Thorax* quite short and broad, quite heavily chitinized and distinctly reticulated; sternal plate (Fig. 55*C*) elongate, rounded.

Pleural plates (Fig. 55*B*) large, overlapping and strongly reticulate or scaly; first pair of ordinary form; second to fifth divided into two lobes by a deep, narrow incision in the posterior margin and with the outer angles somewhat produced; seventh likewise deeply divided into two lobes, these narrow; eighth with a single slender, tapering, dorsal lobe; second to sixth each with two very small setæ at the base of the incision, the seventh and eighth with the usual pairs of slender setæ.

Tergal and sternal plates arranged as usual, strongly developed, all of about the same width and occupying about half the width of the abdomen. Tergal plates with for the most part four small, stout setæ, the sternal plates with six to eight, these smaller than those of the dorsum. Paired setæ of the third sternite large and stout, set on slight prominences.

MALE (Fig. 54). *Length* 0.75 mm. *Pleural plates* as in the female except for the absence of the lobe on the eighth pair. *Tergal and sternal plates* arranged as usual, the tergal plates with for the most part about ten small setæ, the sternal plates with about eight. *Genitalia* (Fig. 55*D*) with no especially distinctive characters.

NOTES.—This species is to be regarded as a member of the *affinis-hesperomydis* group but is marked especially by the dorsal and ventral lobes of the seventh pleural plates and the dorsal lobe of the eighth, as well as by the pronounced angles of the head. Its nearest relative is perhaps the next species.

15. Hoplopleura laticeps n. sp.

FIGS. 55*A*, 56*A*.

SPECIMENS EXAMINED. Two females only from *Arvicanthis univittatus*, mouth of the Benito River, West Africa (U. S. N. M. 101514).

FEMALE. *Length* 1.5 mm. In general appearance closely resembling the preceding, but with the post-antennal angles of the head (Fig. 56*A*) acute and even more pronounced, with the setæ of the abdomen larger and with the third to seventh pleural plates (Fig. 55*A*) quite deeply four-lobed.

NOTES.—I regard this species as most closely related to *H. intermedia*, but in the form of the pleural plates it suggests *H. quadridentata* from South America.

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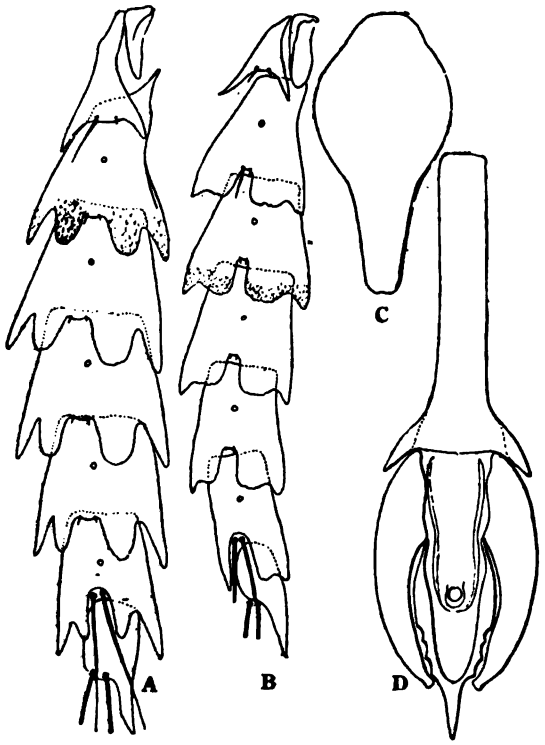

Fig. 55.—*Hoplopleura laticeps* n. sp.: *A*, pleural plates. *Hoplopleura intermedia* Kellogg and Ferris; *B*, pleural plates; *C*, sternal plate.

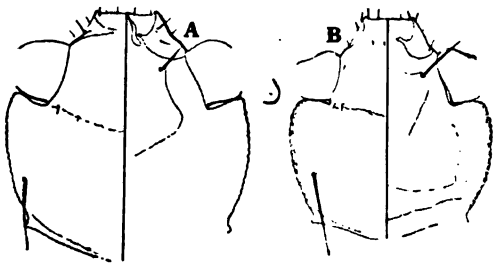

Fig. 56.—Heads of: *A*, *Hoplopleura laticeps* n. sp., and *B*, *H. intermedia* Kellogg and Ferris.

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16. **Hoplopleura enormis** Kellogg and Ferris.

16a. **Hoplopleura enormis enormis** Kellogg and Ferris.

FIGS. 57, 58*B-C*, 59*B*.

1915. *Hoplopleura enormis* Kellogg and Ferris, *Ann. Durban Mus.*, 1: 155, pl. f. 4–4*e*.
1916. *Hoplopleura enormis* K. and F., Ferris, *Ibid.*, 1: 247.
1916. *Hoplopleura enormis* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Ac Sci.* (4), 6: 154.

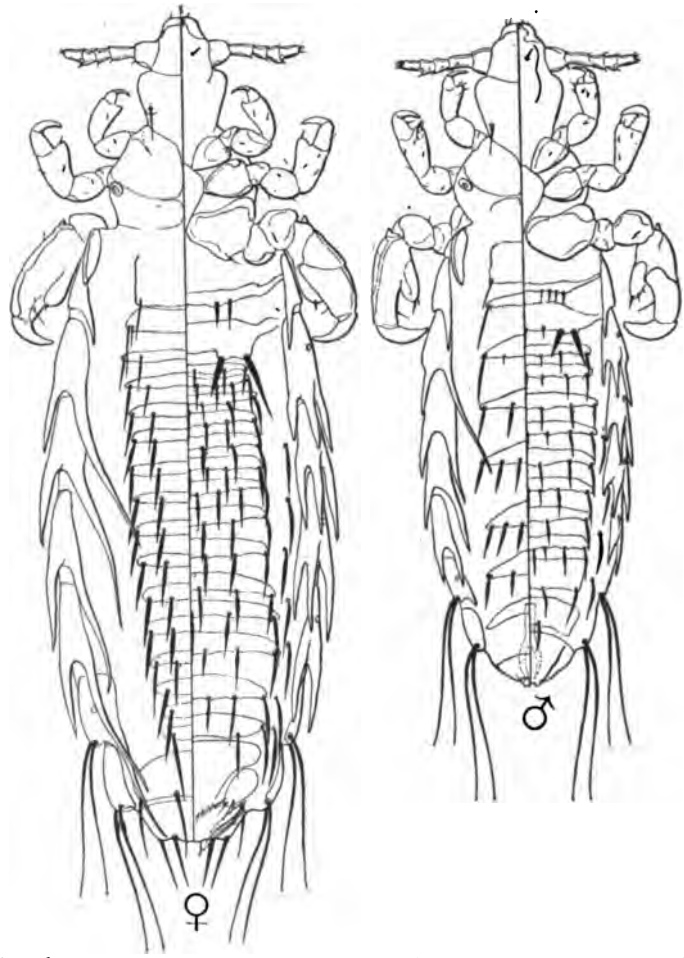

Fig. 57.—*Hoplopleura enormis enormis* K. and F., male and female.

PREVIOUS RECORDS. From *Arvicanthis dorsalis*, Mfongosi, Zululai South Africa. According to Dr. G. S. Miller the proper name for this *Lemniscomys griselda spinalis*.

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SPECIMENS EXAMINED. The types and two females from *Lemniscomys barbarus zebra,* Rhino Camp, Gondokoro, Africa (U. S. N. M. 165195). The hosts are Murids of the subfamily *Murinæ.*

FEMALE (Fig. 57). *Length* 1.3 mm. *Head* (Fig. 58*B*) elongate, the anterior margin narrow and truncate, the post-antennal angles moderately prominent, the lateral margins of the hind head curved and slightly convergent. *Thorax* and legs of ordinary form; sternal plate (Fig. 58*C*) short, broad, and produced but little posteriorly.

Pleural plates (Fig. 59*B*) somewhat scaly; first pair of ordinary form; second with a slender, tapering process both dorsally and ventrally; third to fifth with four and the sixth with three tapering finger-like processes of which the dorsal is nearly twice as long as the plate itself, the others scarcely longer than the plate; seventh with a single dorsal process which is longer than the plate; eighth with no processes; none of the plates with setæ except for the usual pairs of slender setæ on the seventh and eighth.

Tergal and sternal plates arranged as usual, strongly developed, occupying about half the width of the abdomen. Tergal plates with for the most part four quite stout setæ; sternal plates with five to eight setæ, those of the median area smaller than the others. Paired setæ of the third sternite large and long, set on slight prominences.

MALE (Fig. 57). *Length* 1 mm. *Pleural plates* in general as in the female, but with the dorsal processes tending to be shorter, that of the seventh pair practically obsolete. *Tergal and sternal plates* arranged as usual. Tergal plates with for the most part four to six rather stout setæ, sternal plates with six to seven, these smaller than those of the dorsum. *Genitalia* not in condition for description.

NOTES.—The specimens from *Lemniscomys barbarus zebra* differ from the type in having the dorsal processes of the pleural plates noticeably shorter. However, the two specimens available are in poor condition, and I do not care to base a name upon them. It is possible that these represent *Pediculus spiculifer* Gervais, recorded as from a subspecies of this host (*"Mus barbarus"*) but the original description is too inadequate to permit a decision, especially as there is every probability that there is another species also on this host.

This is a most extraordinary form, but it is evident that the remarkable character of the pleural plates is merely an extreme development of the conditions seen in *H. quadridentata* and *H. laticeps.* The affinities of the species are probably with *laticeps.*

It is possible that the two forms described below should be recognized as distinct species, but they are evidently very close to *H. enormis,* and I should wish to know something of the amount of variation before placing them as such. For the present I regard them as subspecies of *enormis.*

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16b. Hoplopleura enormis pelomydis n. ssp.

FIGS. 58*A*, 59*A*.

SPECIMENS EXAMINED. Type from *Pelomys fallax iridescens,* Summit Sagalla, British East Africa (U. S. N. M. 183667). Holotype a female. Also from *Lemniscomys pulchellus,* River Ja, Cameroon (U. S, N. M. 125426), and *Lemniscomys striatus ardens,* Wambugu, British East Africa (U. S. N. M. 163646). The hosts are Murids of the subfamily *Murinæ.*

FEMALE. *Length* 1.3 mm. Differing from the female of *H. enormis enormis* in the form of the pleural plates (Fig. 59*A*), the sixth pair having

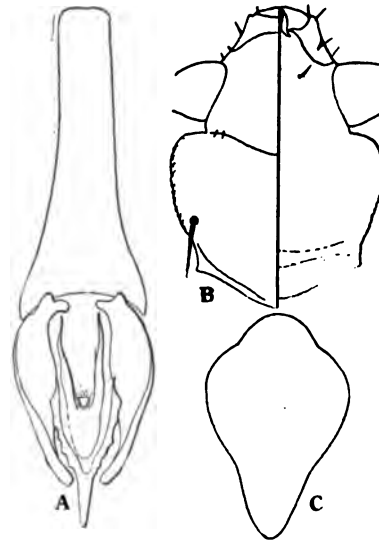

Fig. 58.—*Hoplopleura enormis pelomydis* n. sp.: *A,* genitalia of male. *Hoplopleura enormis enormis* K. and F.: *B,* head; *C,* sternal plate.

four processes instead of three, the seventh pair two processes instead of three and having no long setæ, and the eighth having a single long dorsal process.

MALE. *Length* 1 mm. Differing from the male of *H. enormis enormis* in having the dorsal process of each pleural plate, except the third, shorter than the second process. *Genitalia* (Fig. 58*A*) with no especially distinctive characters.

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16c. Hoplopleura enormis mylomydis n. ssp.

FIG. 59C.

SPECIMENS EXAMINED. From *Mylomys roosevelti,* Kaimosi (U. S. N. M. 183602), and Molo (F. C. M. 16842), British East Africa. Types from the first-named locality. Holotype a female. The host is a Murid of the subfamily *Murinæ.*

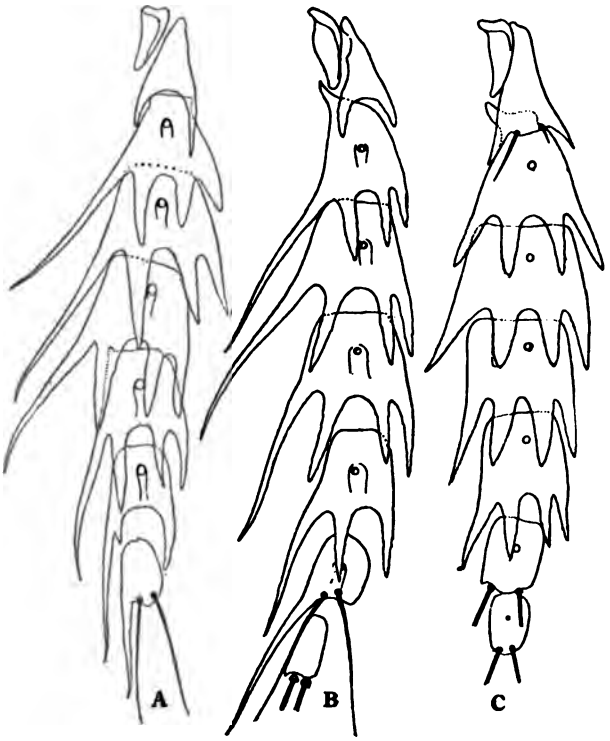

FIG. 59.—Pleural plates of females of: *A, Hoplopleura enormis pelomydis* n. sp.; *B, H. enormis enormis* K. and F.; *C, H. enormis mylomydis* n. sp.

FEMALE. Length 1.5 mm. Resembling the type form except that the second pair of pleural plates bear two setæ, the dorsal process on each plate is but little longer than the others, and the seventh plate bears no process.

MALE. *Length* 1.1 mm. Resembling the type form except that the dorsal process is on none of the pleural plates longer than the second process.

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17. **Hoplopleura merionidis** n. sp.

FIG. 60.

SPECIMENS EXAMINED. Three females from *Meriones psammophilus*, Shensi, China (U. S. N. M. 172528). The host is a Murid of the subfamily *Gerbillinæ*.

Fig. 60.—*Hoplopleura merionidis* n. sp.; *A*, female; *B*, sternal plate; *C*, pleural plates.

FEMALE (Fig. 60*A*). *Length* 1.1 mm. *Head* elongate, acute anteriorly, with slight prominences at the post-antennal angles and with the lateral margins of the hind head nearly parallel. *Thorax* and legs of ordinary form; sternal plate (Fig. 60*B*) short and shield-shaped.

Pleural plates (Fig. 60*C*) but slightly or not at all scaly; first pair of ordinary form; second with a short dorsal tooth and a long, tapering ventral tooth; third to sixth divided into two lobes by a quite deep, curved

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emargination, the outer angles somewhat produced and the posterior margin of the lobes having a ragged appearance; seventh and eighth without lobes; second to sixth with a pair of short setæ in the emargination, the seventh and eighth with the usual pairs of long setæ.

Tergal and sternal plates of the abdomen rather weakly developed, some of them tending to be obsolete, arranged as usual, for the most part with from six to eight slender setæ and with one or two setæ between their ends and the pleurites. Paired setæ of the third sternite, long and slender, borne on slight prominences.

NOTES.—This is apparently a member of the *affinis-hesperomydis* group, but the peculiarly shaped head and sternal plate distinguish it from all other species.

18. Hoplopleura pectinata (Cummings).

FIGS. 61, 62.

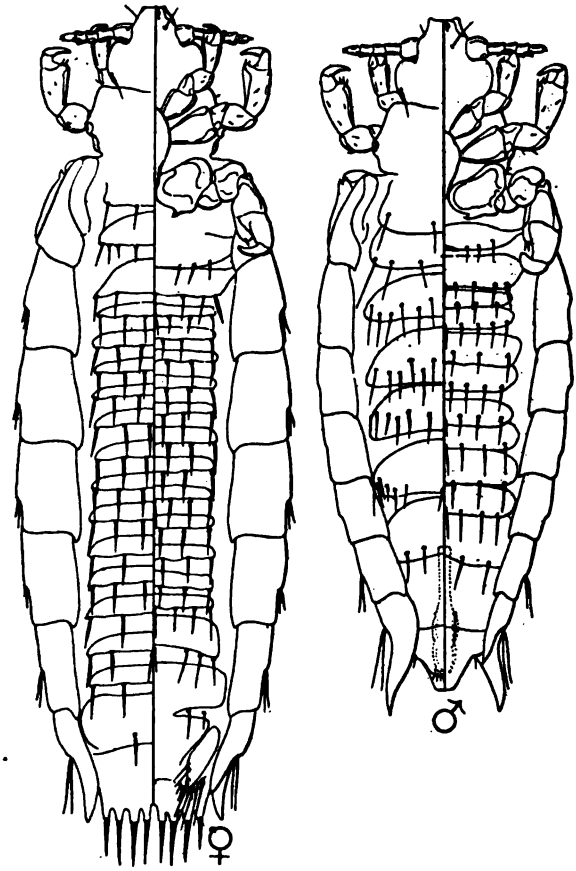

Fig. 61. *Hoplopleura pectinata* (Cummings), male and female.

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1913. *Polyplax pectinata* Cummings, *Bul. Ent. Res.*, **4**: 35.
1916. *Polyplax pectinata* Cum., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 174.
1916. *Hoplopleura pectinata* (Cum.), Ferris, *Ibid.* (4), **6**: 205.

PREVIOUS RECORDS. From *Rattus* (= *Epimys*) *surifer*, Biserat, Jalor, Malay Peninsula. This host was erroneously recorded by Ferris (ref. cited) as *Epimys auifer*.

SPECIMENS EXAMINED. From *Rattus surifer*, Trong, Lower Siam (U. S. N. M. 86750). The host is a Murid of the subfamily *Murinæ*.

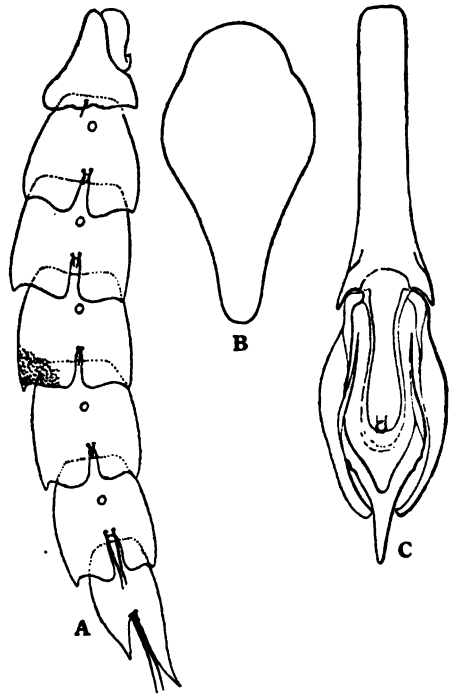

Fig. 62.—*Hoplopleura pectinata* (Cummings): *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

FEMALE (Fig. 61). General form elongate and slender, derm everywhere tending to be chitinized and scaly or reticulated. *Length* 2 mm. *Head* short and broad, narrowly truncate in front, with prominent and acutely rounded post-antennal angles. *Thorax* unusually short and broad, the lateral margins almost straight, the spiracles borne on slight prominences; sternal plate (Fig. 62*B*) rounded, elongate.

Pleural plates (Fig. 62*A*) very large, overlapping, strongly reticulate; first pair apparently not free from the dorsum and but weakly chitinized; third to seventh pairs divided into two broad and nearly equal lobes by a

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deep, narrow incision in the posterior margin and with the outer angles slightly produced; eighth pair likewise with two lobes, but these slender and tapering, the dorsal lobe longer than the ventral; third to sixth pairs with two very small setæ in the incisions, the seventh and eighth with the setæ slightly longer but much shorter than usual.

Tergal and sternal plates arranged as usual, strongly developed, for the most part with four to six small, slender setæ. Paired setæ of the third sternite scarcely or not at all differentiated.

Abdomen terminating in a series of eight quite long, stout spines, each of which is borne at the tip of a low prominence.

MALE (Fig. 61). *Length* 1.25 mm. *Pleural plates* as in the female. *Tergal plates* arranged as usual, very large, occupying the greater part of each segment, for the most part with an irregular row of four to twelve short, slender setæ, these set some distance in from the posterior margin of the plate. *Sternal plates* likewise arranged as usual, each with seven to nine small setæ. *Genitalia* (Fig. 63*C*) with all the parts somewhat elongated, but otherwise not especially distinctive.

NOTE.—This is a peculiar and isolated species, probably finding its nearest relatives in the *affinis-hesperomydis* group, but not intimately connected with any other known form.

19. Hoplopleura neumanni Fahr.

FIG. 63.

1901. *Hæmatopinus præcitus* Neumann, *Arch. de Parasit.*, 5: 600–601, (part). (Typographical error for *præcisus*).
1902. *Hæmatopinus præcisus* Neumann, *Ibid.*, 6: 144, (part).
1908. *Polyplax (?) præcisus* (Neumann), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 13, (part).
1909. *Hæmatopinus (Polyplax) præcisus* Neumann, Neumann, *Arch. de Parasit.*, 13: 523–524, f. 23.
1916. *Hæmatopinus (Polyplax) præcisus* Neumann, Ferris, *Proc. Cal. Acad. Sci.* (4), 6: 178, (part).
1919. *Hoplopleura neumanni* Fahrenholz, *Jahresb. des Niedersäch Zool. Ver.*, p. 26.

PREVIOUS RECORDS. Known only from the original description and record, from "gros rats" in Abyssinia.

SPECIMENS EXAMINED. A single female from the type lot and a single female from *Tatera nigricauda nyama,* Iriola River, British East Africa (U. S. N. M. 183935). The genus *Tatera* belongs to the subfamily *Gerbillinæ* of the family *Muridae.*

FEMALE (Fig. 64). *Length* 1.8 mm. *Head* (Fig. 64*D*) narrowly truncate anteriorly, but little produced in front of the antennæ; post-antennal angles acute and prominent. *Thorax* short and broad, the sternal plate (Fig. 63*B*) somewhat cordate, the legs of the type common to the genus.

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Pleural plates (Fig. 63*C*) as follows: First pair of ordinary form; second with a short dorsal and a longer ventral process; third to sixth each with four slender, acute processes which are slightly shorter than the body of the plate and with a median pair of short, rounded processes from each of which there rises a long, slender seta; seventh with a single slender dorsal process, with two long and one shorter seta; eighth without processes, with the usual pair of slender setæ and two shorter setæ.

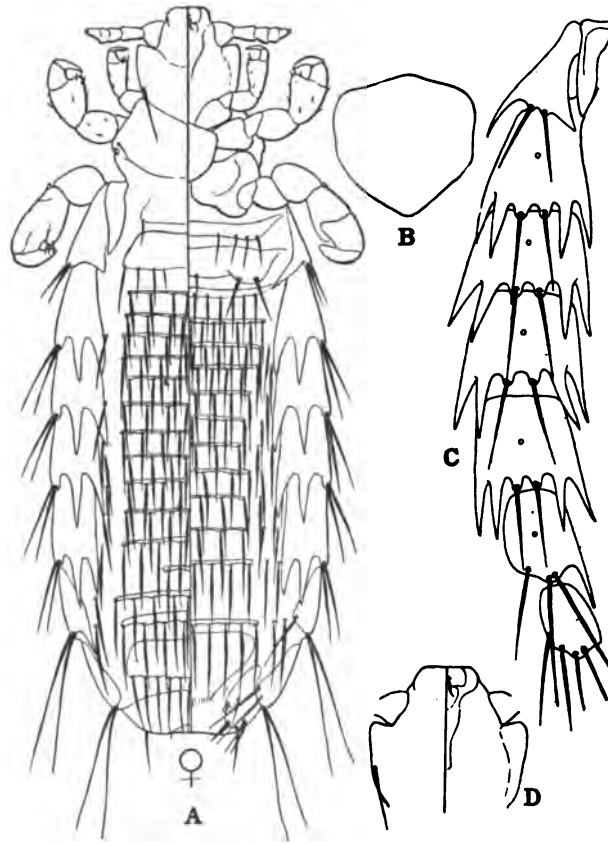

Fig. 63.—*Hoplopleura neumanni* Fahr.: *A*, female; *B*, sternal plate; *C*, pleural plates; *D*, head.

Tergal and sternal plates occupying about half the width of the abdomen, narrow and for the most part bearing from six to ten slender setæ. Fourth to seventh segments with one or two setæ between the ends of each tergal and sternal plate and the pleurites. Paired setæ of the third sternite of ordinary form.

Notes.—In my catalogue of the Anoplura (1916) I expressed the opinion that the original description of *Hæmatopinus præcisus* was based upon specimens repre-

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senting two species of different genera. Fahrenholz (1919) has accepted this viewpoint and (although he has not seen specimens) has pointed out that one of the species is a *Polyplax*, the other a *Hoplopleura*. He has restricted the name *præcisus* to the species of *Polyplax*, which is the male described by Neumann, and has given the name *Hoplopleura neumanni* to the female.

Through the very great kindness of Professor A. Martin of the École Vétérinaire of Toulouse I have been enabled to see one of Neumann's slides and to confirm the above opinions. Unfortunately the female only of *H. neumanni* was represented on this slide, and the male remains unknown.

H. neumanni is one of a peculiar group of African species which includes three other species that I am here describing as new. A relationship with *H. enormis* and its related forms is suggested.

20. Hoplopleura biseriata n. sp.

FIG. 64*A*.

SPECIMENS EXAMINED. A single female from *Malacothrix* sp., Bothaville, Orange Free State, Africa, received through the kindness of Mr.

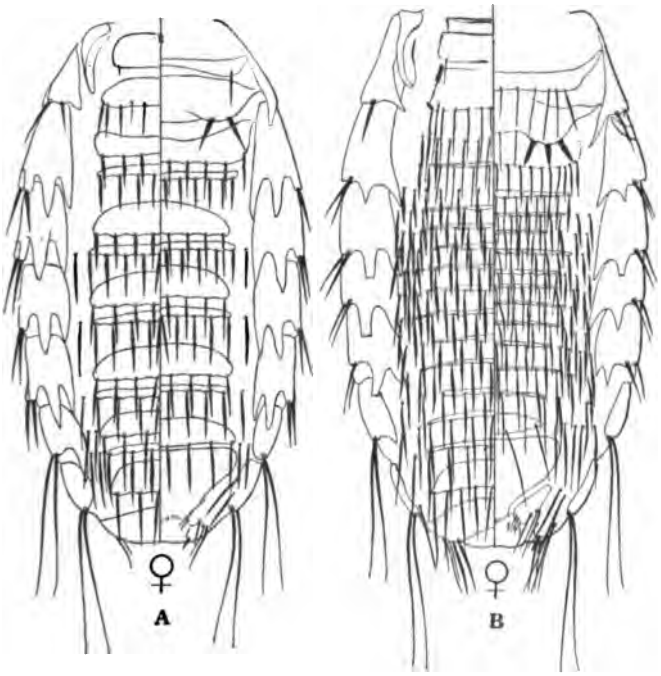

Fig. 64.—Abdomen of female of: *A, Hoplopleura biseriata* n. sp., and *B, H. veprecula* n. sp.

G. A. H. Bedford and now in Mr. Bedford's collection. The host is a Murid of the subfamily *Dendromyinæ*.

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FEMALE (Fig. 64*A*). *Length* not recorded. *Head* rather broad, with quite prominent post-antennal angles. *Thorax* and legs of ordinary form, the sternal plate as in *H. neumanni.*

Pleural plates identical with those of *H. neumanni. Tergal and sternal plates* strongly developed, the third segment both dorsally and ventrally with three plates, the remainder with not more than two. In each case the anterior plate is the broader. Dorsal plates with eight or nine rather stout setæ, ventral plates with 8–10. First plate of the third sternite with the usual paired setæ.

NOTES.—This species is undoubtedly closely related to *H. neumanni,* but the presence of but two tergal and sternal plates on the majority of the abdominal segments is quite distinctive. It is a striking example of how even the most stable characters may at times break down.

21. Hoplopleura cryptica n. sp.

FIGS. 65, 66*B*, 66*D*, 66*E*, 66*G*.

SPECIMENS EXAMINED. From *Tatera liodon smithii,* Kikondu, Uganda (U. S. N. M. 165302). Holotype a female. The host is a Murid of the subfamily *Gerbillinæ.*

FEMALE (Fig. 65). *Length* 1.6 mm. A stout-bodied species. *Head* (Fig. 66*E*) and thorax quite heavily chitinized, the head rather short and broad, with prominent, rounded post-antennal angles. *Thorax* and legs of the usual form, the thorax without the usual pair of dorsal setæ; sternal plate (Fig. 66*D*) slightly broader than long, oval, produced slightly anteriorly and posteriorly.

Pleural plates (Fig. 66*B*) large; first pair of ordinary form; second with short dorsal and ventral teeth; third to sixth each with four slender, finger-like processes which are about half as long as the plate itself and are more or less serrate at the tips; seventh with a single dorsal process; eighth with none; second to sixth each with a pair of stout setæ borne upon prominences between the two median lobes; seventh and eighth with the usual pair of slender setæ and with one to three stout setæ along the ventral margin.

Tergal and sternal plates well developed, arranged as usual, almost concealed beneath the many long, stout setæ, of which each plate bears from ten to twenty. Third sternite with two groups of three stout setæ instead of the usual two pairs.

MALE (Fig. 65). *Length* 1.3 mm. Pleural plates as in the female except for the presence of a short process at the dorsal angle of the seventh plate. Tergal and sternal plates arranged as usual, very large, bearing from fourteen to more than thirty stout setæ. *Genitalia* (Fig. 66*G*)

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with the parameres broad and flattened, the pseudopenis small and weak with the shaft almost obsolete and the arms not serrate.

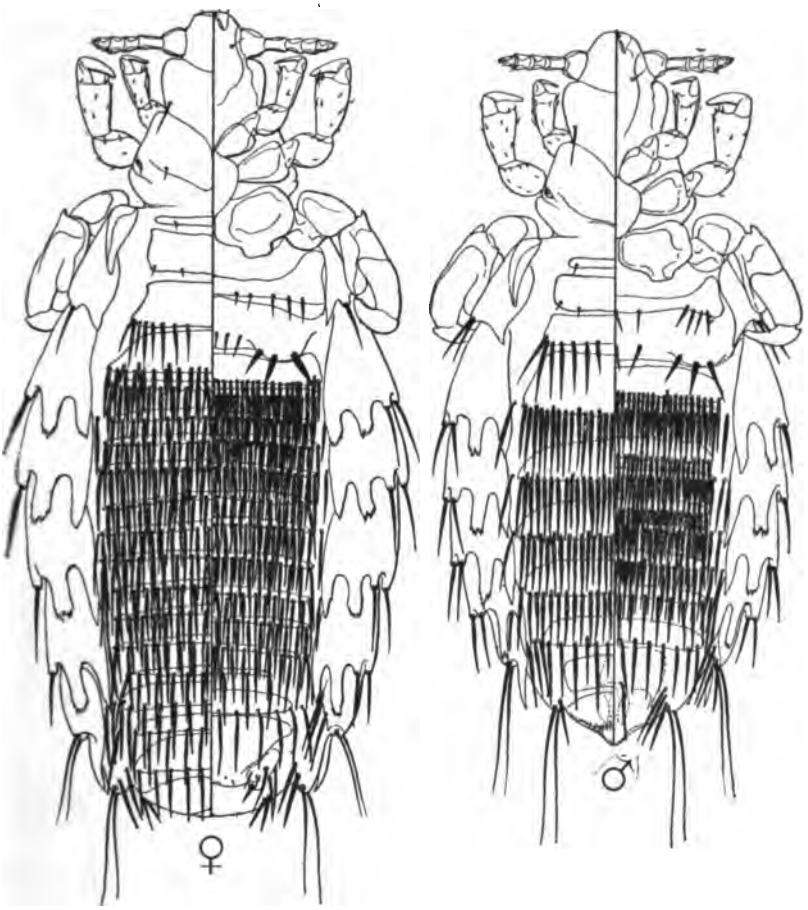

Fig. 65.—*Hoplopleura cryptica* n. sp., male and female.

Notes.—This remarkable species resembles *H. neumanni* in the form of the pleural plates, but is readily distinguishable by the great number of stout setæ.

22. Hoplopleura veprecula n. sp.

Figs. 64*B*, 66*A*, 66*C*, 66*F*.

Specimens Examined. Three females from *Tatera bohmi varia*, South Guaso Nyiro, British East Africa (U. S. N. M. 162250). The host is a Murid of the subfamily *Gerbillinæ*.

Female. *Length* 1.6 mm. *Head* (Fig. 66*F*) somewhat elongate. Sternal plate (Fig. 66*C*) more or less quadrangular. *Pleural plates* (Fig.

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66*A*) with the setæ not borne on prominences and with the lobes shorter than in *H. cryptica* and but little serrate. *Tergal and sternal plates* more weakly developed than in *cryptica* and with from eight to twelve slender setæ.

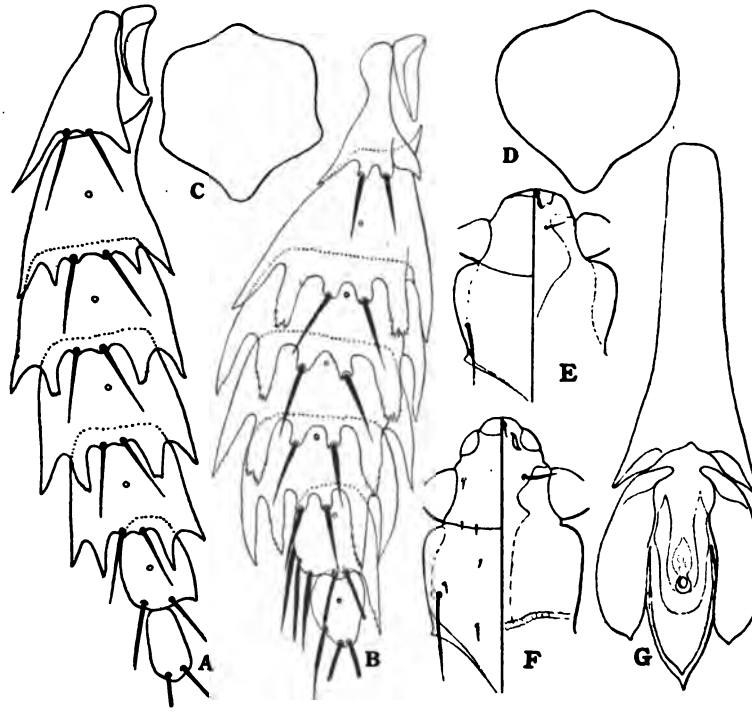

Fig. 66.—*Hoplopleura veprecula* n. sp.: *A*, pleural plates of female; *C*, sternal plate; *F*, head. *Hoplopleura cryptica* n. sp.; *B*, pleural plates of female; *D*, sternal plate; *E*, head; *G*, genitalia of male.

Notes.—This is evidently a close relative of *H. cryptica*, but the more slender head, the differently shaped sternal plate, the differently shaped pleural plates, and the smaller and less numerous setæ render it quite distinct. It differs from *H. neumanni* especially in the shape of the pleural plates, which do not have the setæ borne on prominences.

23. Hoplopleura erratica (Osborn).

(Synonymy under subspecies.)

23a. Hoplopleura erratica erratica (Osborn).

Figs. 67, 68.

1896. *Hæmatopinus erraticus* Osborn, *U. S. Dept. Agric., Div. Ent.*, Bul. 5, n. s.: 186.

1904. *Polyplax* (?) *erratica* (Osb.), Enderlein, *Zool. Anz.*, 28: 143.

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1908. *Polyplax* (?) *erratica* (Osb.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 13.
1915. *Hoplopleura* (?) *erratica* (Osb.), Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.*, p. 18.
1916. *Hoplopleura erratica* (Osb.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 155.

PREVIOUS RECORDS. Type said to have been taken from a gull (*Larus* sp.), but this evidently is an error. Also recorded by Osborn from

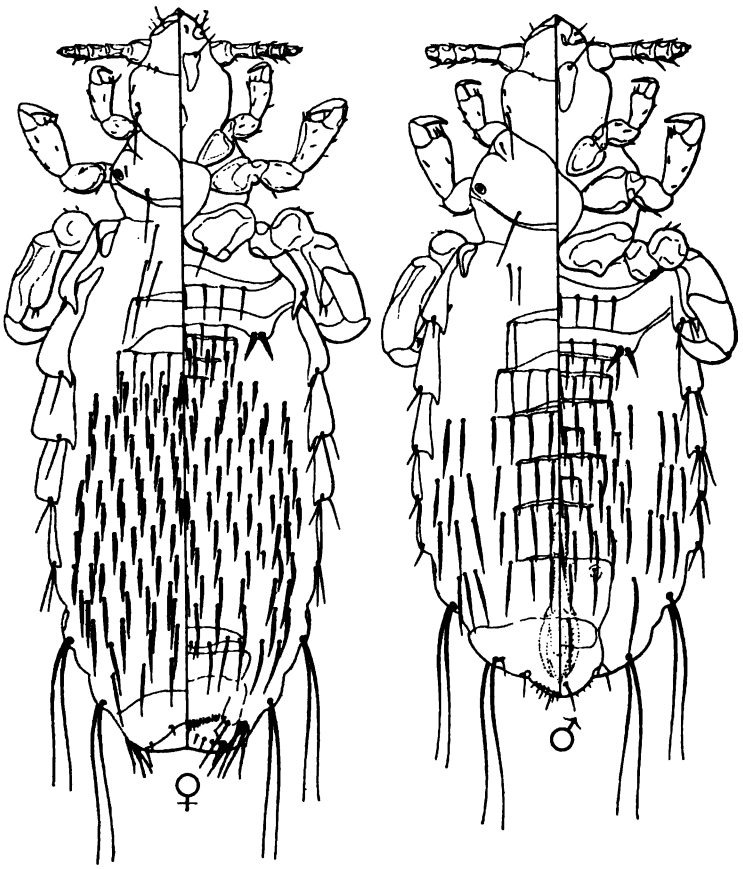

Fig. 67.—*Hoplopleura erratica erratica* (Osb.), male and female.

Sciuropterus volans (= *volucella*), *Microtus* (= *Arvicola*) *pennsylvanicus* and *Tamias* (= *Sciurus*) *striatus*. As is indicated in the notes below, all these records except that of *Tamias striatus* are to be regarded as erroneous, and this is to be taken as the type host. The host is a Sciurid of the subfamily *Sciurinæ*.

SPECIMENS EXAMINED. From *Tamias striatus*, Sing Sing, New York (U. S. N. M. 135553); Washington, D. C. (U. S. N. M.); Clarks-

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ville, Tenn. (U. S. N. M. 35147); Waterloo, Ind.; *Eutamias alpinus,* Tuolumne Meadows, Cal. The hosts are Sciurids.

FEMALE (Fig. 67). *Length* 1.1 mm. *Head* acutely rounded anteriorly, with slight post-antennal angles and with a pair of small, chitinized areas on the ventral side between the bases of the antennæ. *Thorax* and legs with no unusual characters except for the absence of the olecranon process on the posterior tibiæ; sternal plate (Fig. 68*B*) triangular, with the apex posteriorly.

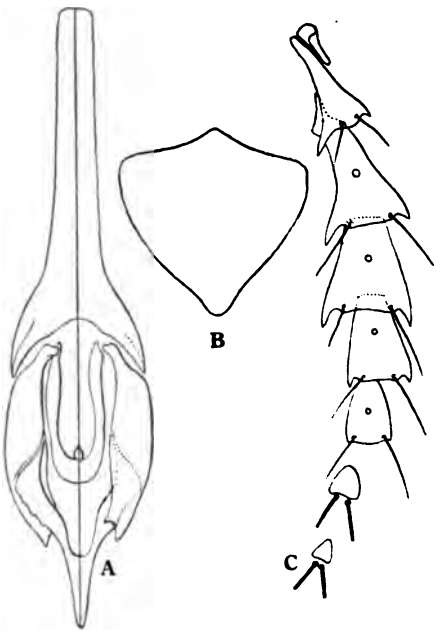

Fig. 68.—*Hoplopleura erratica erratica* (Osb.): *A*, genitalia of male; *B*, sternal plate; *C*, pleural plates of female. From specimens from *Tamias striatus,* Clarksville, Tenn.

Pleural plates (Fig. 68*C*) rather small, overlapping but little, not scaly; first pair of ordinary form; second with a short dorsal tooth and a slightly longer ventral tooth; third to fifth each with each posterior angle produced into a slight tooth; sixth to eighth without teeth; second to sixth each with a pair of slender setæ and the seventh and eighth with the usual pairs of long setæ.

Tergal and sternal plates undeveloped except for the two anterior plates of the third tergite, the second sternite and the three plates of the third sternite and the first plate of the fourth sternite. Rows of setæ, however, arranged in the normal manner, for the most part with ten to

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twelve rather stout setæ. Paired setæ of the third sternite small, stout, close together on slight prominences.

MALE (Fig. 67). *Length* 0.9 mm. *Pleural plates* as in the female. *Tergal and sternal plates* very weakly developed, arranged in the usual manner, with from eight to ten setæ and with two or three setæ between the ends of the plates and the pleurites on the fourth to seventh segments. *Genitalia* (Fig. 68*A*) with the basal plate rather long and slender, the parameres notched at the tip, and the pseudopenis with short, strongly bent arms, which are but little longer than the shaft.

NOTES.—The original description of this species is unusually inadequate and affords not even a hint as to the identity of the species. The types, however, are still in existence in the collection of the Boston Society of Natural History, and Mr. C. W. Johnson, curator of that collection, has kindly examined them for me and has also sent me some other specimens from *Tamias striatus,* from the Osborn collection, which he considers to be the same species. Accepting his conclusions (and they are probably correct) the species of *Hoplopleura* infesting *Tamias striatus* will stand as *H. erratica.*

This species may be regarded as the type of a group which occurs in part on hosts of the family *Sciuridæ* and in part on *Muridæ,* the group being distinguished chiefly by the simplicity of the pleural plates.

23b. Hoplopleura erratica arboricola Kellogg and Ferris.

1915. *Hoplopleura arboricola* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.,* p. 19, pl. 4, f. 8; tf. 6, 7, (part).

1916. *Hoplopleura arboricola* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 154, (part).

1916. *Hoplopleura arboricola* K. and F., Ferris, *Psyche,* **23**: 112, (part).

PREVIOUS RECORDS. Type (see notes below) from *Eutamias hindsi,* Inverness, Marin County, Cal. Also from *Eutamias townsendi ocrogenys,* Freestone and Cazadero; *Eutamias speciosus frater,* Yosemite National Park; *Eutamias merriami pricei,* Stanford University, and *Eutamias* species, Covelo and South Yolla Bolly Mountain, California. Erroneously recorded from *Eutamias alpinus, Sciurus griseus* and *Sciurus douglasi,* California, and *Tamias striatus,* Iowa. The hosts are Sciurids.

SPECIMENS EXAMINED. As above recorded.

FEMALE. Differing from that of *H. erratica erratica* only in the presence of very attenuated plates on all the segments of the abdomen.

MALE. Apparently not differing from that of *H. erratica erratica.*

NOTES.—In the original description of this species there were included specimens from *Sciurus douglasi, S. griseus,* and *Tamias striatus.* Those from the species of *Sciurus* and from *Tamias* I now regard as distinct species. No type was designated, and in a later note (1916) I designated as the type host *Sciurus douglasi albolimbatus.* This was in error, as specimens from this host were not included in the original description. The matter of the type is therefore still open, and I designate as lectotypes specimens from *Eutamias hindsi,* Inverness, Cal.

This form is very close to *H. erratica* and more or less intergrades with it.

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24. Hoplopleura sciuricola n. sp.

FIGS. 69, 70.

1915. *Hoplopleura arboricola* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.*, p. 19, (part).

1916. *Hoplopleura arboricola* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 154, (part).

1916. *Hoplopleura arboricola* K. and F., Ferris, *Psyche*, **23**: 112, (part).

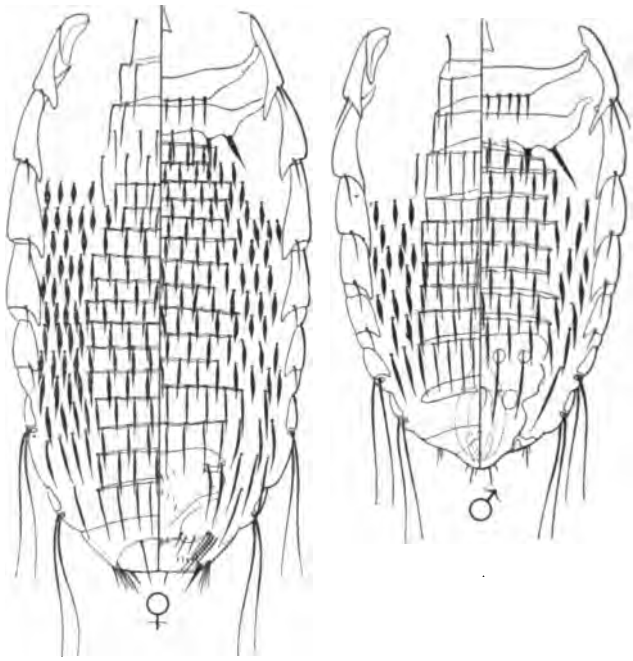

Fig. 69.—*Hoplopleura sciuricola* n. sp., abdomen of male and female.

PREVIOUS RECORDS. Recorded as *Hoplopleura arboricola,* from *Sciurus griseus, S. douglasi alboli*mbatus and *S. douglasi mollipilosus,* from various points in California.

SPECIMENS EXAMINED. As above recorded and from the following: Holotype (a female) and allotype from *Sciurus carolinensis,* Bayou St. Louis, Miss. (U. S. N. M. 23691), and Tarpon Springs, Fla.; *S. arizonensis huachuchæ,* Huachucha Mountains, Arizona; *S. griseogena,* Macuto, Venezuela (F. C. M. 17621); *S. hudsonicus petulans,* Glacier Bay, Alaska, and *S. hudsonicus vancouverensis,* Kuiu Islands, Alaska; *S. kaibabensis,* Kaibab National Forest, Arizona (U. S. N. M. 168301); *S. nesæus,* Margarita Island, Venezuela (F. C. M. 16606); *S. variabilis saltusensis,* Palomina, Colombia (U. S. N. M. 107224); *S. ignitus,* Rio San

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Miguel, Peru (U. S. N. M. 194488); *Sciurus sp.*, Rio Combrecito, Peru (U. S. N. M. 194486); *Sciurus* sp., Buena Vista, Bolivia (F. C. M.).

FEMALE (Fig. 70). *Length* 1.6 mm. *Head* as in *H. erratica. Sternal plate* (Fig. 71*B*) somewhat more elongate than in *erratica. Pleural plates* (Fig. 71*B*), with the posterior angles of all but the seventh and eight pairs produced, more so than in *erratica,* and with the posterior margin smoothly emarginate.

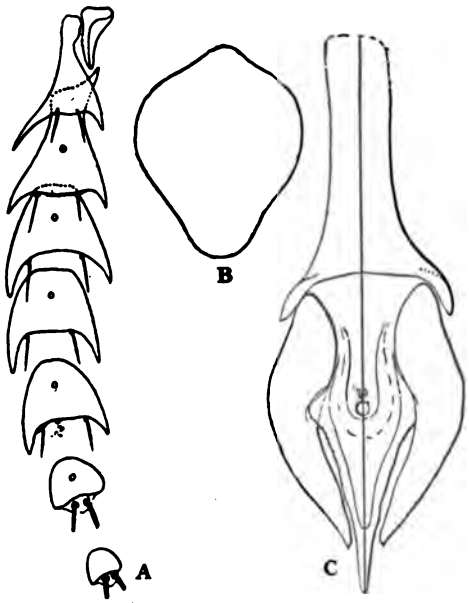

Fig. 70.—*Hoplopleura sciuricola* n. sp.: *A,* pleural plates of female; *B,* sternal plate; *C,* genitalia of male. From types.

Tergal and sternal plates present but very slender, bearing for the most part 6–10 setæ. Between the ends of all the plates and the pleurites on the fourth to eighth segments are from four to six setæ, these much stouter than those along the plates. Paired setæ of the third sternite quite large and slender, well separated, borne on small prominences.

MALE (Fig. 70). *Length* 1.2 mm. *Head, thorax, and pleural plates* as in the female. Third to seventh abdominal tergites and third to seventh sternites each with two plates and two rows of eight to ten setæ, the plates small. Between the ends of all the plates and the pleurites on the fourth to seventh segments are from two to four setæ, which are much stouter than those along the plates.

Genitalia (Fig. 71*C*) with the ends of the parameres acute and not notched, the arms of the pseudopenis long and slender.

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NOTES.—Owing in part to a failure to appreciate the characters of importance and in part to the inadequacy of the microscopic preparations employed this species has heretofore been confused by the present writer with *H. erratica* and *H. erratica arboricola*. However, it is very distinct, the presence of two rows of setæ on the third to seventh tergites of the male being sufficient evidence of this. The females are not greatly different from those of *H. erratica arboricola*, although there are slight differences in the form of the pleural plates. The size and number of the abdominal setæ are subject to considerable variation, but the other characters, especially of the male, remain quite constant throughout the rather large series examined.

25. Hoplopleura maniculata (Neum.).

FIGS. 71, 72*A*, 72*D*, 72*G*.

1909. *Hæmatopinus* (*Polyplax*) *maniculatus* Neumann, *Arch. de Parasit.*, **13**: 521, f. 21, 22.

1915. *Hoplopleura* (*?*) *maniculata* (Neum.), Kellogg and Ferris, *Ann. Durban Mus.*, **1**: 155.

1916. *Hoplopleura maniculata* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 156.

PREVIOUS RECORDS. From *Funambulus* (=*Sciurus*) *palmarum*, Rajkote, India. Also recorded by Neumann from specimens from Navapour, India, which were erroneously attributed to a bat, *Scotophilus wroughtoni*.

SPECIMENS EXAMINED. A female from the material recorded from Navapour, received through the kindness of Professor G. H. F. Nuttall, and males and females from *Funambulus tristriatus*, Colombo, Ceylon (U. S. N. M. 114084). The hosts are Sciurids.

FEMALE (Fig. 71). *Length* 1.3 mm. *Head* rounded in front, with slight post-antennal angles and with a pair of rather large, chitinized areas on the ventral side between the antennæ. *Thorax* and legs of normal form, the posterior tibiæ apparently without the usual olecranon process; sternal plate (Fig. 72*A*), triangular, with broadly rounded angles.

Pleural plates very similar to those of *H. erratica*, but with the posterior angles slightly more produced; none of the plates with the anterior angles produced laterally (Fig. 72*D*).

Tergal and sternal plates strongly developed, occupying at least three-fourths of the width of the abdomen, for the most part with from six to nine rather small setæ; fifth to seventh segments with one or two setæ between the end of each plate and the corresponding pleurite. Paired setæ of the third sternite set close together on slight prominences.

MALE (Fig. 71). *Length* 0.7 mm. *Pleural plates* as in the female. *Tergal and sternal plates* presenting the normal arrangement, strongly developed, with for the most part 8–10 slender setæ, those of the sternum smaller than those of the dorsum. One or two setæ present between the

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ends of the fourth to seventh tergal plates and the posterior sternal plate of the fifth to seventh segments and the corresponding pleurites.

Genitalia (Fig. 72*G*) with the basal plate slender, expanded posteriorly, the parameres slender and not notched at the apex, the pseudopenis with the arms strongly curved.

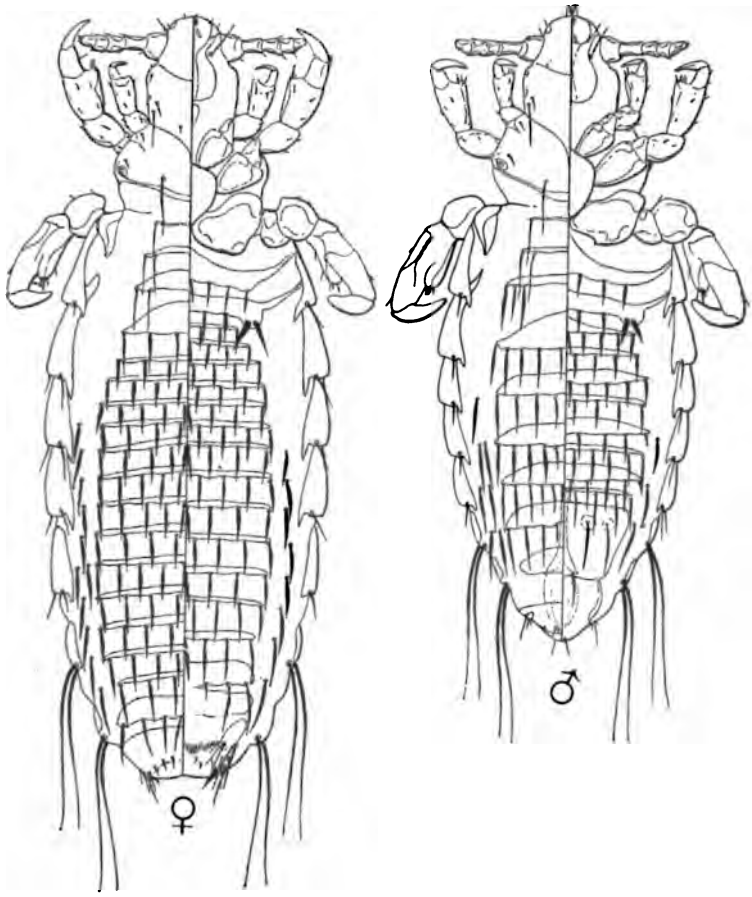

Fig. 71.—*Hoplopleura maniculata* (Neum.), male and female. From specimens from *Funambulus tristriatus,* Colombo, Ceylon.

Notes.—This species is very similar to *H. erratica,* the differences which distinguish it being only the markedly stronger development of the tergal and sternal plates and the slightly different genitalia of the male.

26. Hoplopleura erismata n. sp.

Figs. 72*B*, 72*E*, 72*F*.

Specimens Examined. From *Sciurus ferrugineus cinnamomeus,* South East Siam (U. S. N. M. 201408), (holotype, a female, and allo-

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type); *Sciurus davisoni*, Trong, Lower Siam (U. S. N. M. 83495); *Tamiops* sp., Tenasserim, Telok Besar (U. S. N. M. 124254). The hosts are Sciurids.

FEMALE. In all respects practically identical with *H. maniculata* except that the fourth and fifth pairs of pleural plates have the anterior

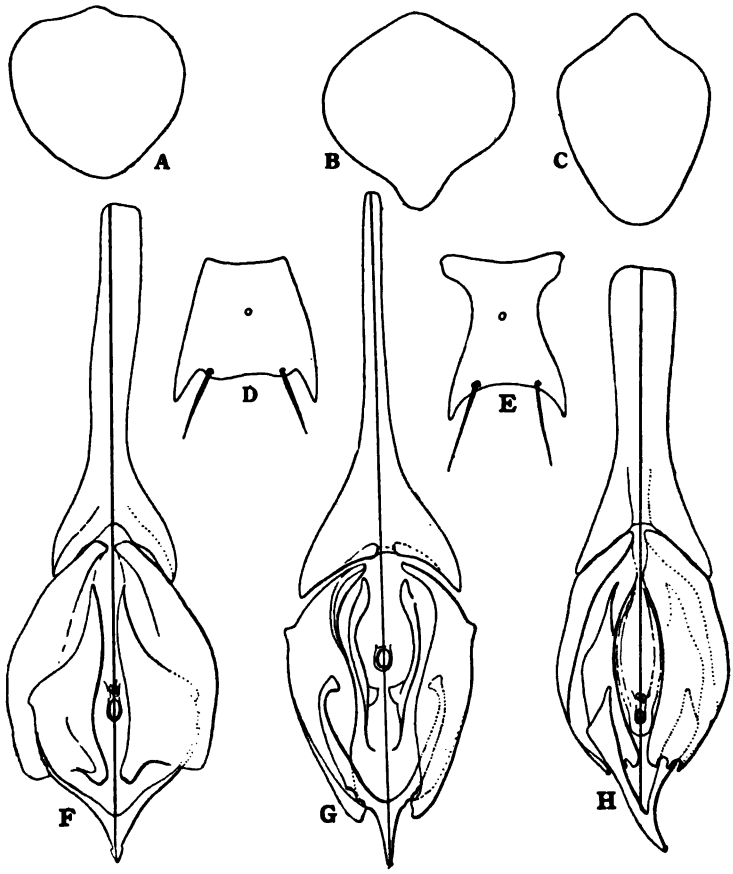

Fig. 72.—*Hoplopleura maniculata* (Neum.): *A*, sternal plate; *D*, fourth pleural plate; *G*, genitalia of male. *H. erismata* n. sp.: *B*, sternal plate; *E*, fourth pleural plate; *F*, genitalia of male. *H. distorta* n. sp.: *C*, sternal plate; *H*, genitalia of male.

angles strongly produced laterally (Fig. 72*E*). Sternal plate (Fig. 72*B*) slightly broader than in *maniculata*.

MALE. In general closely resembling the male of *H. maniculata*, but with the pleural plates differing as in the female and with the genitalia very different. *Genitalia* (Fig. 72*F*) with the parameres strongly ex-

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panded and flattened, the pseudopenis small and slender, with widely diverging arms.

NOTES.—This is evidently very close to *H. maniculata,* yet the differences noted are very definite and it seems certainly to be a distinct species.

27. Hoplopleura distorta n. sp.

FIGS. *72C, 72H.*

SPECIMENS EXAMINED. From *Rhinosciurus* sp., Hsing-lung-shan, 65 miles northeast of Peking, China (U. S. N. M. 199559). Holotype a male. The host is a Sciurid.

FEMALE. Almost identical with that of *H. maniculata,* but with the fourth and fifth pairs of pleural plates with shoulders as in *H. erismata* and with the outer seta of each of the pairs on the third sternite strongly curved. *Sternal plate* (Fig. *72C*) elongate.

MALE. Closely resembling the male of *H. maniculata,* but with the pleural plates and the paired setæ of the third sternite differing as in the female. *Genitalia* (Fig. *72H*) with the parameres broad and with the tips twice notched and with the pseudopenis curved to one side, the arms stout, forming a V and not serrate.

NOTES.—Like *H. erismata,* to which it is probably most closely related, this species very closely resembles *H. maniculata,* yet the differences noted are very sharp and constant.

28. Hoplopleura trispinosa Kellogg and Ferris.

FIGS. 73, 74.

1915. *Hoplopleura trispinosa* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.,* p. 22, pl. 4, f. 3; tf. 8.

1916. *Hoplopleura trispinosa* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), 6: 157.

1916. *Hoplopleura trispinosa* K. and F., Ferris, *Psyche,* 23: 111, f. 11*d.*

PREVIOUS RECORDS. Type from *Sciuropterus* (= *Glaucomys*) sp., Brownsville, Ore. Also from *Sciuropterus sabrinus lascivus,* Yosemite National Park, California, and *S. volans* (= *volucella*), Kensington, Md.

SPECIMENS EXAMINED. As above listed. The hosts belong to the *Petauristidæ.*

FEMALE (Fig. 73). *Length* 1 mm. *Head* rounded in front, with slight post-antennal angles and with a pair of small, chitinized areas on the ventral side between the bases of the antennæ. *Thorax* and legs of ordinary form, the posterior tibiæ without the usual olecranon process; sternal plate (Fig. 74*B*) of a somewhat triangular form.

Pleural plates (Fig. 74*C*) with the posterior angles of the second to sixth pairs produced into short teeth and with a pair of short setæ on the posterior margin.

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Tergal and sternal plates well developed, occupying somewhat more than half the width of the abdomen and with for the most part six to nine short setæ, the fourth to seventh segments with a single seta between the end of each plate and the corresponding pleurite. Third sternite with two groups of three setæ each, the outer seta in each group strongly curved.

MALE (Fig. 73). *Length* 0.75 mm. *Head, thorax,* and *pleural plates* as in the female. *Tergal and sternal plates* arranged as usual, well developed, with for the most part from six to nine setæ. Fourth to seventh segments with two or three setæ between the ends of each tergal plate and one seta between the posterior sternal plate and the corresponding pleurite.

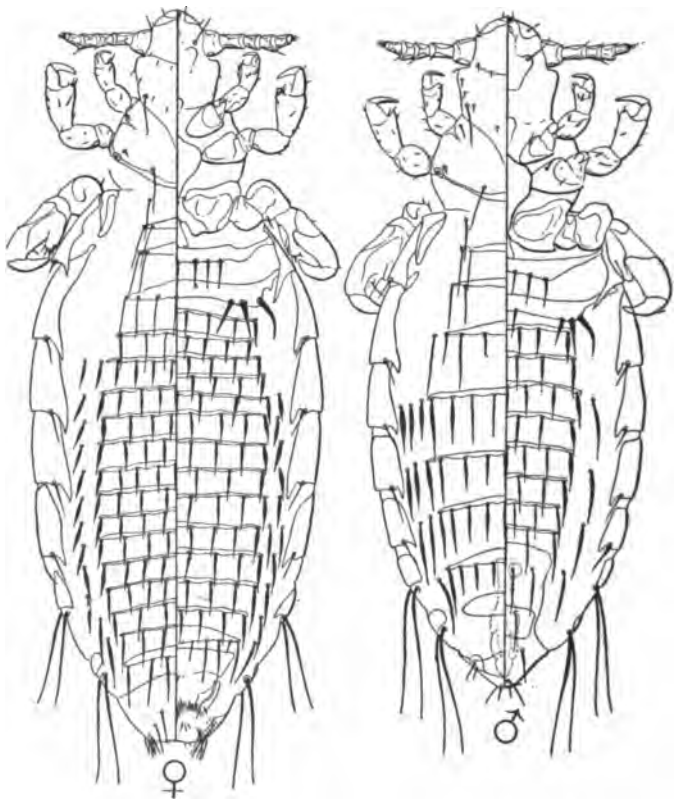

Fig. 73.—*Hoplopleura trispinosa* K. and F., male and female. From specimens from *Sciuropterus alpinus lascivus,* California.

Genitalia (Fig. 74*A*) of an unusual type, the basal plate broad and expanded at each end, the parameres very short and stout, the pseudopenis V-shaped and articulating with the tips of the parameres.

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NOTES.—This species is in general appearance very similar to the other members of the *erratica* group, but the presence of three setæ in each group on the third sternite, together with the curved outer seta of these groups and the peculiar genitalia of the male are quite distinctive.

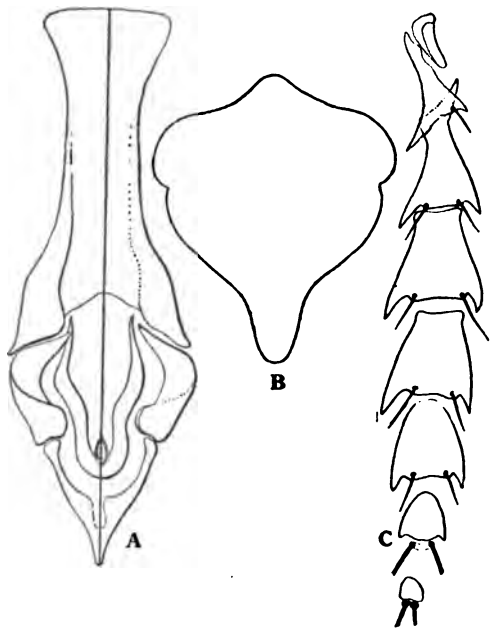

FIG. 74.—*Hoplopleura trispinosa* K. and F.: *A*, genitalia of male; *B*, sternal plate; *C*, pleural plates of female.

29. Hoplopleura hirsuta Ferris.

FIGS. 75, 76.

1916. *Hoplopleura hirsuta* Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 155 (without description).

1916. *Hoplopleura hirsuta* Ferris, *Psyche*, **23**: 112, f. 8, 9*A*, 10, 11*B*.

PREVIOUS RECORDS. Type from *Sigmodon hispidus hispidus*, Raleigh, N. C. Also from *S. hispidus texianus*, Rockport, Tex., and *S. hispidus eremicus*, Sacaton, Ariz., and Fort Yuma, Cal.

SPECIMENS EXAMINED. As above recorded and the following: *Sigmodon ocrognathus*, Parral, Chihuahua, Mexico (U. S. N. M. 96268); *S. peruanus*, Pacasmayo, Peru (F. C. M. 19216); *Xenomys nelsoni*, Hacienda Magdalena, Colima, Mexico; *Rhipidomys venustus*, Merida, Venezuela (U. S. N. M. 137507). The last two hosts were represented by but a single specimen each and the records are probably untrustworthy. The hosts are Murids of the subfamily *Cricetinæ*.

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FEMALE (Fig. 75). *Length* 1.4 mm. *Head* rather slender, narrowly rounded in front, with slight post-antennal angles and with the lateral margins of the hindhead converging but little. *Thorax* and legs of ordinary form; sternal plate (Fig. 76*B*) rounded, produced but little posteriorly.

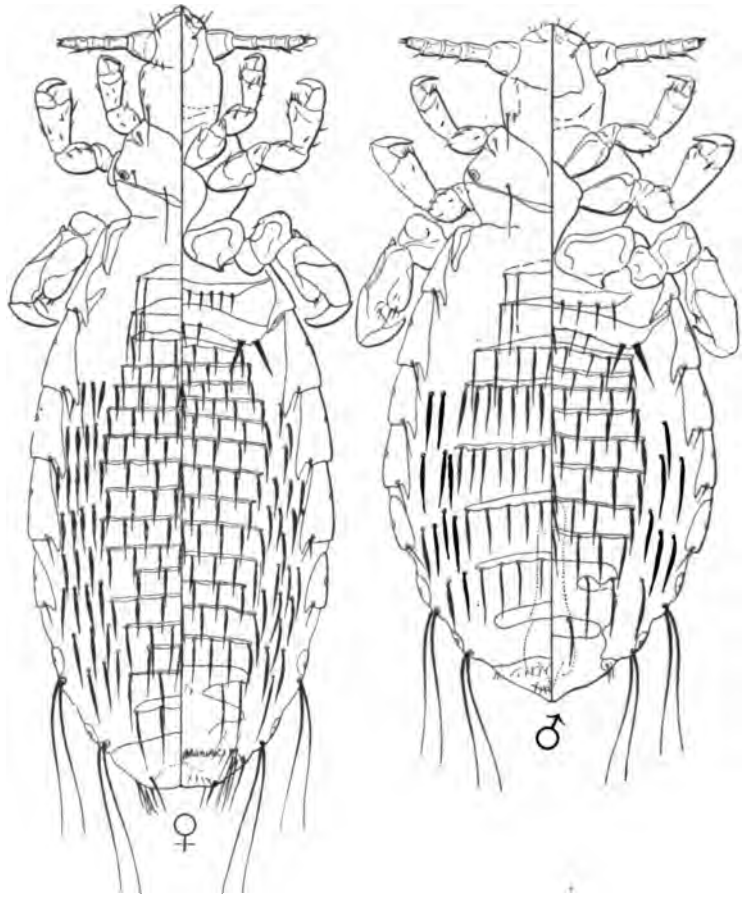

Fig. 75.—*Hoplopleura hirsuta* Ferris, female from specimen from *Sigmodon hispidus eremicus,* Sacaton, Ariz., and male from specimen from *S. hispidus hispidus,* Raleigh, N. C.

Pleural plates (Fig. 76*C*) relatively small, overlapping but little, first pair of ordinary form; second to sixth with each posterior angle prolonged into a short tooth and with the posterior margin between the teeth nearly straight; seventh and eighth without teeth; second to sixth each with a pair of small setæ, seventh and eighth with the usual slender setæ.

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Tergal and sternal plates of the abdomen very attenuated, arranged as usual, for the most part with four to eight rather slender setæ. Fourth to seventh segments with three or four setæ between the ends of most of the plates and the corresponding pleurites. Paired setæ of the third sternite well developed, set on slight prominences.

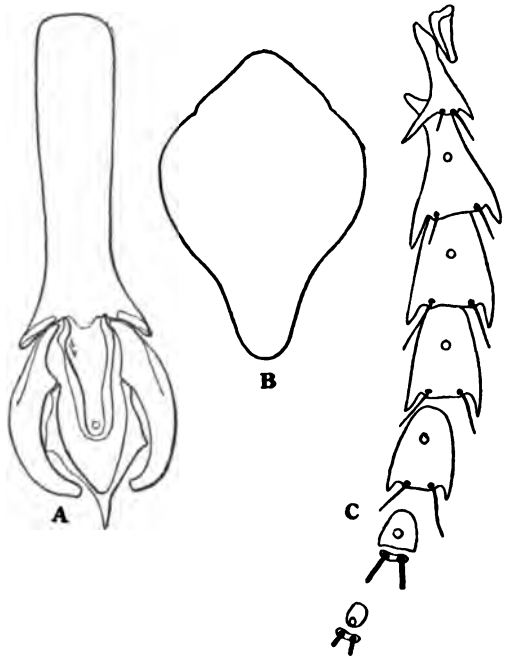

Fig. 76.—*Hoplopleura hirsuta* Ferris: *A*, genitalia of male; *B*, sternal plate; *C*, pleural plates of female.

MALE (Fig. 75). *Length* 1 mm. *Pleural plates* as in the female. *Tergal and sternal plates* of the abdomen arranged as usual, for the most part with four to twelve setæ, those of the ventral side shorter and relatively stouter than those of the dorsum. Fourth to seventh segments with from one to four setæ between the ends of the plates and the corresponding pleurites.

Genitalia (Fig. 76*A*) with the parameres strongly curved, not notched at the tip and with the arms of the pseudopenis angular.

NOTES.—Although the hosts of this species are all Murids it resembles most closely the species of the *erratica* group which occur on the *Sciuridæ*. In fact it differs significantly from *H. erratica arboricola* only in the somewhat differently shaped sternal plate and in the genitalia of the male, the parameres not being notched at the tip.

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30. Hoplopleura phaiomydis n. sp.

FIGS. 77, 78.

SPECIMENS EXAMINED. From *Phaiomys* sp., East Ladak, Kashmir (U. S. N. M. 198570). Holotype a male. The host is a Murid of the subfamily *Microtinæ*.

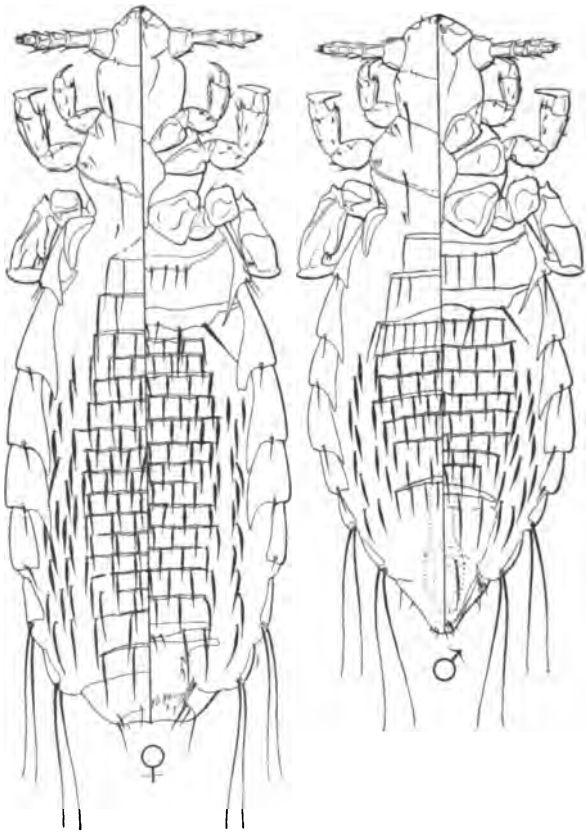

Fig. 77.—*Hoplopleura phaiomydis* n. sp., male and female.

FEMALE (Fig. 77). Length 1.3 mm. *Head* narrowly rounded anteriorly, with slight post-antennal angles. *Thorax* and legs of ordinary form; sternal plate (Fig. 78*B*) with sharp lateral angles and with the posterior portion strongly produced.

Pleural plates (Fig. 78*A*) overlapping but little; first pair of ordinary form; second pair with a short dorsal tooth and a longer, tapering ventral tooth; third to fifth pairs with both posterior angles produced into quite long, tapering teeth; sixth to eighth without teeth; second to sev-

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enth with a pair of small setæ, seventh and eighth with the usual slender setæ.

Tergal and sternal plates of the abdomen slender, with for the most part four to eight slender setæ. Fourth to seventh segments with one or two stouter setæ between the ends of the plates and the corresponding pleurites.

MALE (Fig. 77). *Length* 1 mm. *Pleural plates* as in the female. *Tergites* of the abdomen with two rows of setæ on the third to sixth seg-

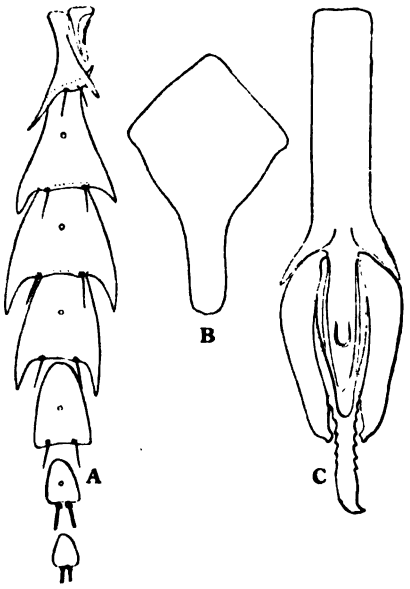

Fig. 78.—*Hoplopleura phaiomydis* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

ments. *Sternites* with the usual arrangement of the plates. All the plates slender, weakly developed, with for the most part six to eight small setæ. Fourth to seventh segments with one or two larger setæ between the ends of the plates and the corresponding pleurites.

Genitalia (Fig. 78*C*) with the parameres nearly straight and nearly as long as the basal plate; pseudopenis unusually large, the arms short and slender, the shaft long and stout and with its margins toothed.

NOTES.—In the form of the pleural plates this species closely resembles the species of the *erratica* group, although its host is a Murid. It is marked chiefly by the presence of two rows of setæ on the third to sixth tergites of the male, a character that appears elsewhere only in *H. acanthopus* and *H. sciuricola*, and by the peculiar genitalia of the male, in which it is approached only by *H. oxymycteri* n. sp.

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31. Hoplopleura oxymycteri n. sp.

FIGS. 79, 80.

SPECIMENS EXAMINED. From *Oxymycterus* sp., Occabamba Pass, Peru (U. S. N. M. 194701). Holotype a male. The host is a Murid of the subfamily *Cricetinæ*.

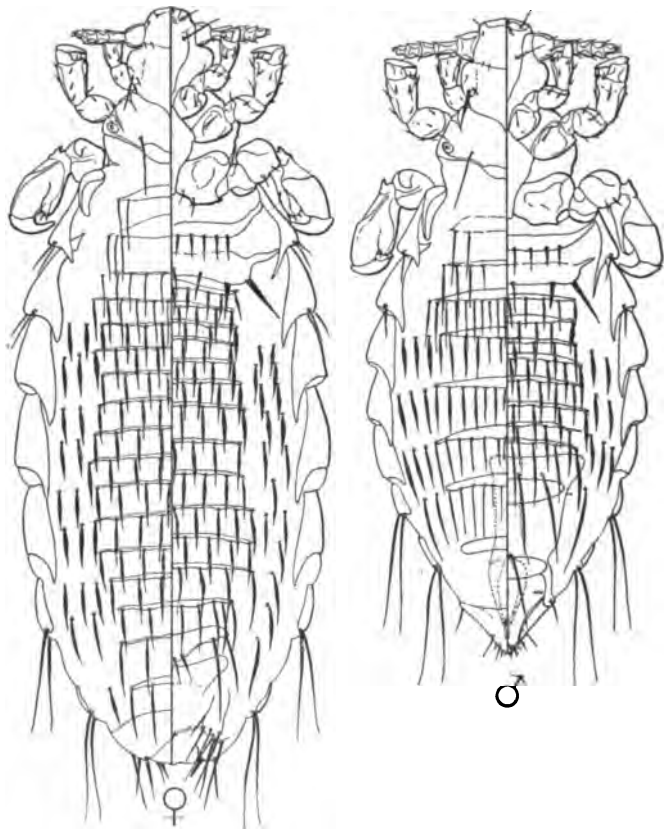

Fig. 79.—*Hoplopleura oxymycteri* n. sp., male and female.

FEMALE (Fig. 79). *Length* 1.4 mm. *Head* short and almost truncate in front, with quite prominent post-antennal angles. *Thorax* and legs of ordinary form; sternal plate (Fig. 80*B*) with sharp lateral angles and strongly produced posteriorly.

Pleural plates (Fig. 80*A*) overlapping but little; first pair of ordinary form; second with a short dorsal tooth and a longer, tapering ventral tooth; third to sixth pairs with each posterior angle produced into a long, tapering tooth; seventh and eighth without teeth; second and third

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with a pair of small setæ, the remainder without setæ except for the usual long pairs on the seventh and eighth.

Tergal and sternal plates of the abdomen slender, arranged as usual, the tergal plates with for the most part four to eight slender setæ. Fourth to seventh segments with two or three stouter setæ between the ends of part of the plates and the corresponding pleurites.

MALE (Fig. 79). *Length* 1 mm. *Pleural plates* as in the female. *Tergal and sternal plates* arranged as usual, the tergal plates with for the most part as many as twelve slender setæ, the sternal plates with eight or nine, these somewhat stouter than those of the dorsum. Fourth to sev-

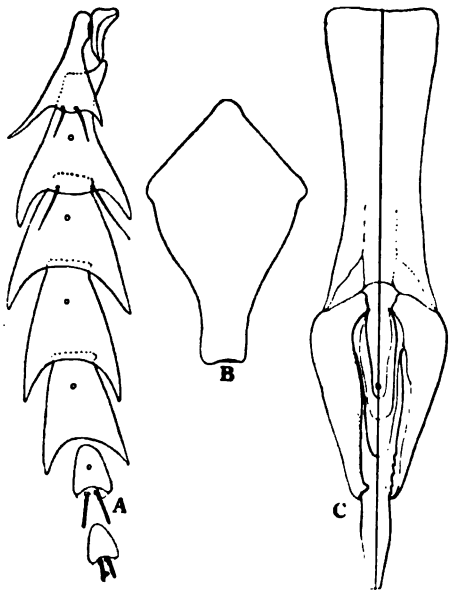

Fig. 80.—*Hoplopleura oxymycteri* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

enth segments with one to three setæ between the ends of the plates and the corresponding pleurites.

Genitalia (Fig. 80*C*) with the parameres nearly as long as the basal plate, straight, tapering and nearly parallel; the pseudopenis unusually large, the arms short and slender, the shaft long and stout, serrate for part of its length.

NOTES.—In the shape of the pleural plates this species resembles the members of the *erratica* group. It is distinguishable chiefly by the absence of setæ on most of the pleural plates, by the shape of the sternal plate and by the peculiar genitalia of the male. In the latter character it resembles *H. phaiomydis* n. sp., from which it differs in having but one row of setæ on all the tergites except the third in the male.

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32. Hoplopleura reducta n. sp.

FIG. 81.

SPECIMENS EXAMINED. From *Phyllotis micropus,* Chubut, Valle del Lago Blanco, Argentina (F. C. M. 18891). Females only. The host is a Murid of the subfamily *Cricetinæ.*

FEMALE (Fig. 81*A*). *Length* 1.1 mm. *Head* rather acute in front, with very slight post-antennal angles, somewhat elongate. *Thorax* and legs of ordinary form; sternal plate (Fig. 81*B*) roughly quadrangular, with an acute median, posterior process.

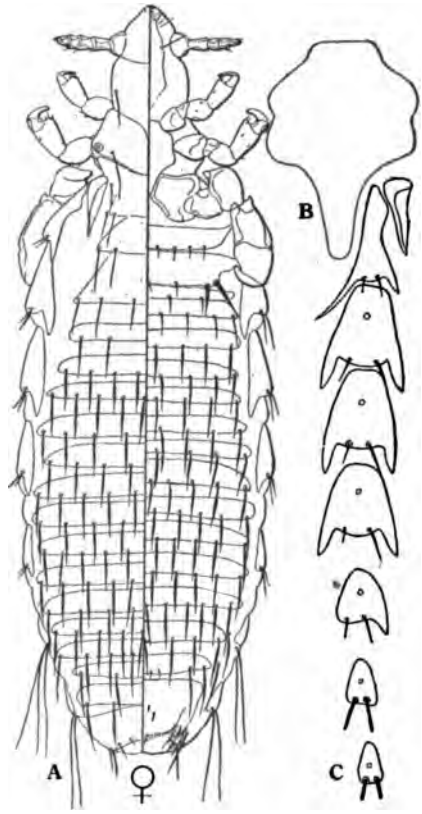

Fig. 81.—*Hoplopleura reducta* n. sp.: *A,* female; *B,* sternal plate; *C,* pleural plates.

Pleural plates (Fig. 81*C*) small, not at all overlapping; first pair of ordinary form; second with a short dorsal tooth and a longer, tapering ventral process; third to fifth with each posterior angle produced into a slender tooth; sixth with the dorsal angle alone produced into a tooth; seventh and eighth without teeth; second to sixth each with a pair of small

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setæ; seventh and eighth with the usual slender setæ. *Tergal and sternal plates* of the abdomen very strongly developed, reaching almost from one side of the abdomen to the other, arranged in the normal manner. Plates for the most part with from eight to nine slender setæ. Paired setæ of the third sternite slender, set close together.

NOTES.—This species appears to be a member of the *erratica* group. It is distinguished chiefly by the unusual development of the tergal and sternal plates of the abdomen.

33. **Hoplopleura audax** n. sp.

FIGS. 82, 83.

SPECIMENS EXAMINED. From *Prœchimys semispinosus* (types, holotype a female) (U. S. N. M. 113273), and *Nelomys mirœ*, San Javier, North Ecuador (U. S. N. M. 113303). The hosts are Octodontids.

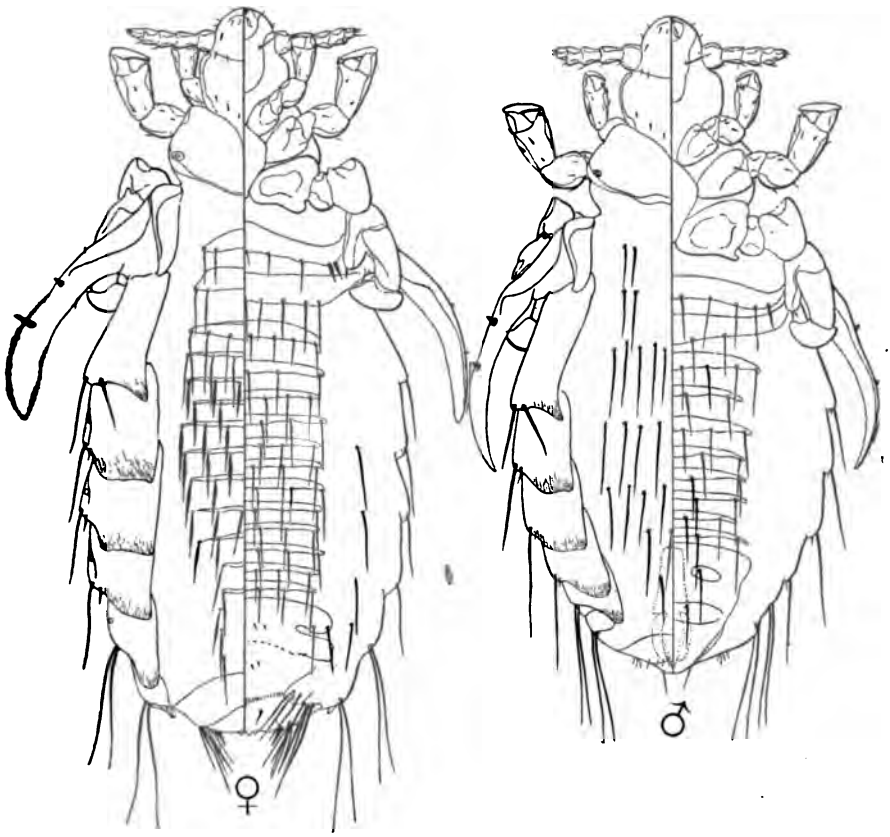

Fig. 82.—*Hoplopleura audax* n. sp., male and female.

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FEMALE (Fig. 82). *Length* 1.3 mm. *Head* broadly rounded in front, with slight post-antennal angles. *Thorax* and legs of ordinary form; sternal plate (Fig. 83*A*) bluntly produced posteriorly.

Pleural plates of unusual form; first pair of ordinary character; second greatly elongated, forming a long, curved, flattened process that projects wing-like from the side of the abdomen; remaining plates lying entirely upon the dorsum, large, overlapping and with the posterior portion marked by fine, longitudinal striations; third pair with the dorsal angle produced into a slight tooth; fourth to sixth with a broad dorsal lobe; seventh and eighth with a narrow, rounded dorsal lobe; third with a pair of slender setæ; fourth to sixth each with one short and one long seta; seventh and eighth with the usual pairs of slender setæ.

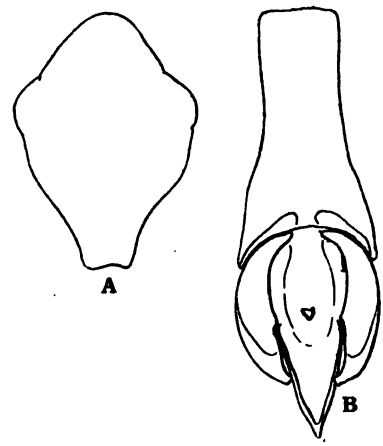

Fig. 83.—*Hopopleura audax* n. sp.: *A*, sternal plate; *B*, genitalia of male.

Tergal and sternal plates of the abdomen arranged as usual, the dorsal plates small, tending to become obsolete posteriorly, the ventral plates well developed; dorsal plates with from two to six rather stout setæ, ventral plates with for the most part six slender setæ. Paired setæ of the third sternite lacking, the second sternite instead at times with small, paired setæ.

MALE (Fig. 82). *Length* 0.95 mm. *Pleural plates* as in the female except for the absence of the lobe on the eighth pair. *Abdomen* without tergal plates, but with the setæ arranged as usual, each row with from two to eight, all slender. Sternal plates well developed, arranged as usual, for the most part with four to eight slender setæ.

Genitalia (Fig. 83*B*) with the basal plate short and broad; parameres short and crescent-shaped; pseudopenis V-shaped, the shaft almost obsolete, the arms slender.

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NOTES.—This is a most peculiar form, quite unlike any species heretofore described, finding its only near relative in *H. alata* n. sp., which is described below. These two species might possibly be regarded as forming a distinct genus, yet I consider that their relationships are with *Hoplopleura*, and they may rest quite comfortably in that genus for the present.

34. Hoplopleura alata n. sp.

FIGS. 84, 85.

SPECIMENS EXAMINED. From *Kerodon australis*, Upper Rio Chico, Patagonia (U. S. N. M. 84175). Holotype a female. The host is an Octodontid.

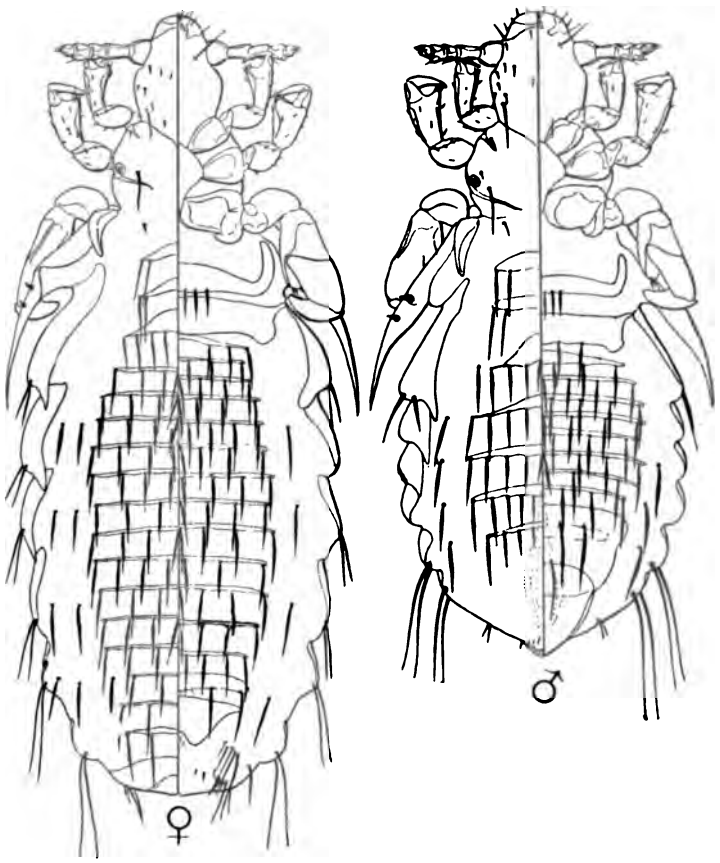

Fig. 84.—*Hoplopleura alata* n. sp., male and female.

FEMALE (Fig. 84). *Length* 1 mm. *Head* rounded anteriorly, with slight post-antennal angles. *Thorax* and legs of ordinary form, the posterior tibiæ without the usual olecranon process; sternal plate (Fig. 85*C*)

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triangular, with the apex anteriorly and with a short, median posterior process.

Pleural plates (Fig. 85*A*) of the same type as in *H. audax* but without the longitudinal striations; second pair produced into a narrow, tapering, blade-like process; third with a short, curved tooth at each posterior angle; fourth to sixth with the dorsal angle alone somewhat produced; seventh and eighth small, rounded; second with a pair of short, stout setæ, remainder with a pair of long, slender setæ.

Tergal and sternal plates arranged as usual, well developed, bearing for the most part six or seven slender setæ. Paired setæ of the third sternite lacking.

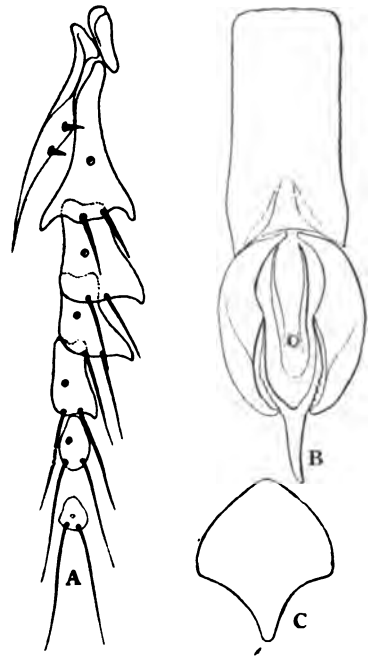

Fig. 85.—*Hoplopleura alata* n. sp.: *A*, pleural plates of female; *B*, genitalia of male; *C*, sternal plate.

MALE (Fig. 84). *Length* 0.75 mm. *Pleural plates* as in the female except that setæ are lacking on the fourth to sixth pairs. *Tergal and sternal plates* well developed, arranged as usual, with for the most part seven to eight setæ. *Genitalia* (Fig. 85*B*) with the basal plate short and broad; parameres crescent-shaped; pseudopenis with the arms curved and about as long as the shaft.

NOTES.—This is quite closely related to *H. audax*, described above, but the marked differences in the pleural plates are enough to distinguish it.

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35. Hoplopleura bidentata (Neumann).

FIGS. 86, 87.

1909. *Hæmatopinus* (*Polyplax*) *bidentatus* Neumann, *Arch. de Parasit.*, **13**: 515, f. 18.

1913. *Polyplax bidentatus* (Neum.), Johnston and Harrison, *Proc. Royal Soc. Queensland*, **24**: 108.

1915. *Hoplopleura* (*?*) *bidentata* (Neum.), Kellogg and Ferris, *Ann. Durban Mus.*, **1**: 155.

1916. *Hoplopleura bidentata* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4), **6**: 154, 205.

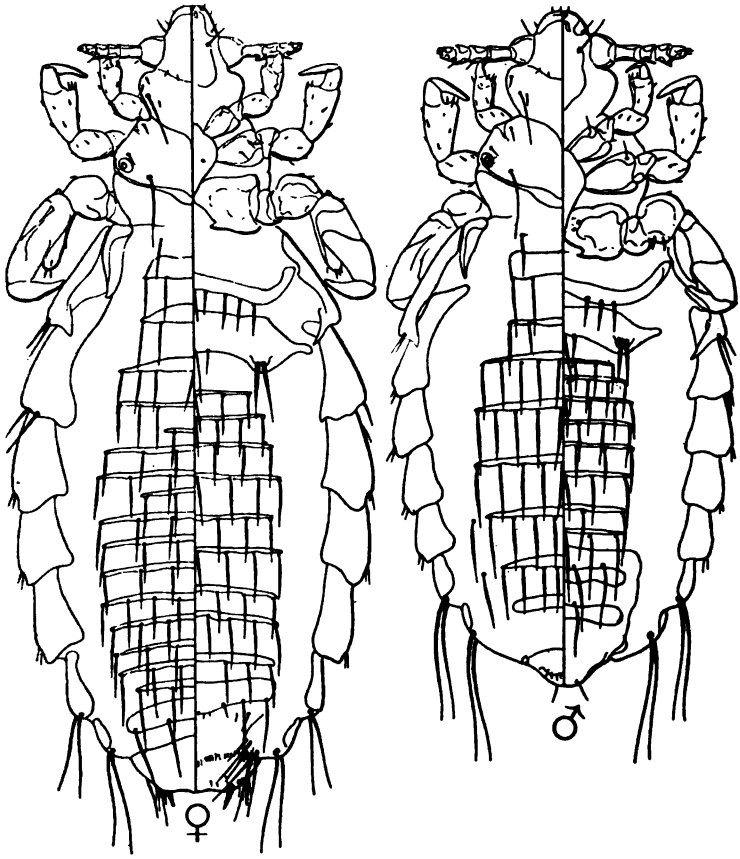

Fig. 86.—*Hoplopleura bidentata* (Neum.), male and female.

PREVIOUS RECORDS. Originally attributed by Neumann to *Mus rattus*, Lake Torrens, Australia. Johnston and Harrison, however, have shown that this attribution is in error and that the specimens undoubtedly came from *Hydromys chrysogaster*. They have recorded the species from this host at Sydney, Australia.

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SPECIMENS EXAMINED. From *Hydromys chrysogaster,* New South Wales, Australia (U. S. N. M. 83708). The host is a Murid of the subfamily *Hydromyinæ.*

FEMALE (Fig. 86). *Length* 1.3 mm. *Head* narrow and rounded in front of the antennæ, with quite prominent post-antennal angles and with the lateral margins of the hind head curved and strongly convergent. *Thorax* and legs of ordinary form; sternal plate (Fig. 87*B*) roughly circular with a broad, blunt, median, posterior process.

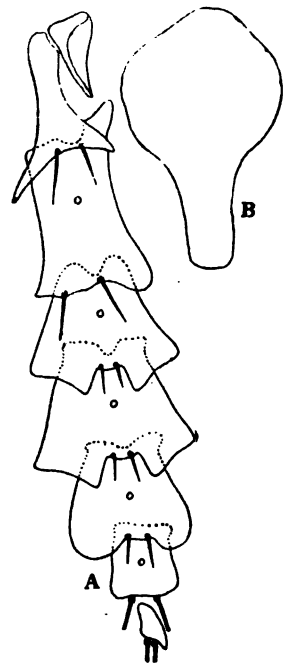

Fig. 87.—*Hoplopleura bidentata* (Neum.): *A,* pleural plates of female; *B,* sternal plate.

Pleural plates (Fig. 87*A*) strongly developed and overlapping; first pair of ordinary form; second with a short, tapering dorsal tooth and a longer ventral process; third with the dorsal angle produced and rounded, the ventral angle acute; fourth to sixth pairs divided into two lobes by a rather shallow median incision in the posterior margin, the lobes of the sixth pair rounded, the others angular; seventh plate rectangular, without lobes; eighth very small; second to sixth with a pair of small setæ; seventh and eighth with the usual slender setæ.

Tergal plates of the abdomen arranged as usual, well developed, with for the most part six slender setæ. *Sternal plates* with an unusual ar-

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rangement, the third segment alone having three, the fourth to seventh each with but two plates and two rows of setæ. Paired setæ of the third sternite long and slender, set close together.

MALE (Fig. 86). *Length* 0.9 mm. *Pleural plates* as in the female. *Tergal and sternal plates* of the abdomen arranged as usual, well developed, the tergal plates with eight or nine setæ, the sternal plates with five or six. *Genitalia* of the single available specimen not in condition for description.

NOTES.—This is an isolated species having no close relatives among the other members of the genus. I can not avoid a feeling that it has some connection with *H. audax* and *H. alata*, although the resemblances are indeed few.

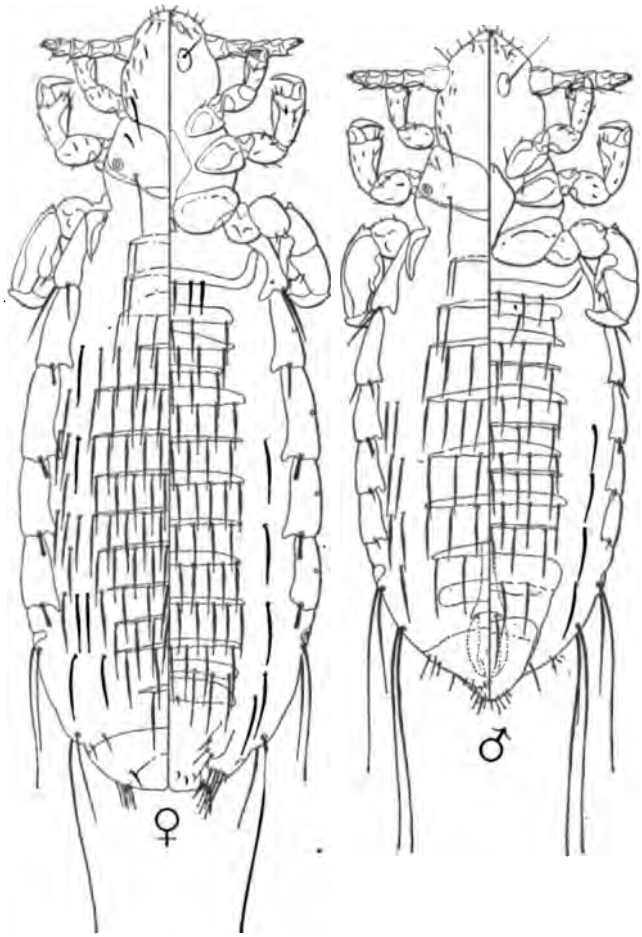

Fig. 88.—*Hoplopleura disgrega* n. sp., male and female.

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36. Hoplopleura disgrega n. sp.

FIGS. 88, 89.

SPECIMENS EXAMINED. From *Octodontomys simonsi*, Orura, Bolivia (U. S. N. M. 121167). Holotype a female. The host is an Octodontid.

FEMALE (Fig. 88). *Length* 0.9 mm. *Head* rounded anteriorly, with practically no post-antennal angles. *Thorax* and legs of ordinary form; sternal plate (Fig. 89*B*) rounded, produced anteriorly and posteriorly.

Pleural plates (Fig. 89*A*) overlapping but little, not reticulate or scaly; first pair of ordinary form; second with a slight tooth at the dorsal and ventral angles; third to fifth each with a curved, subapical tooth at each angle; sixth with the dorsal angle prolonged into a tooth; seventh very small, without teeth; eighth obsolete; second with a pair of slender setæ, third to sixth each with a pair of short, flattened setæ, the tips of which have a slightly serrate appearance as if they had been broken; seventh pair and the margin of the eighth segment with a pair of slender setæ.

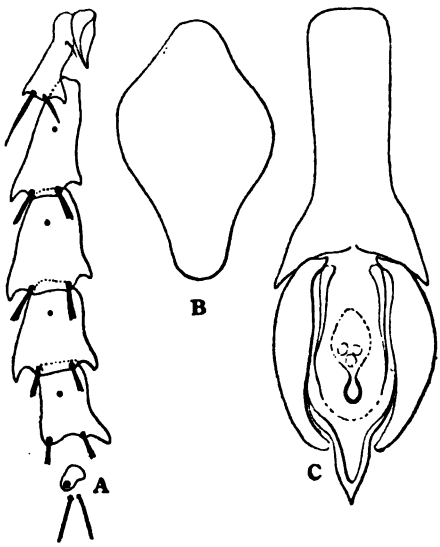

Fig. 89.—*Hoplopleura disgrega* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

Tergal and sternal plates of the abdomen well developed, the third segment alone having three plates both dorsally and ventrally, the fourth to seventh segments with but two plates and two rows of setæ. Tergal plates with for the most part 6–10 slender setæ, the fourth to seventh segments with 1–3 setæ between the ends of the plates and the pleurites.

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Sternal plates with 5–10 setæ, the paired setæ of the third sternite lacking and with the first plate of the third segment not extending across the segment.

MALE (Fig. 88). *Length* 0.7 mm. Pleural plates as in the female. *Tergal and sternal plates* well developed, arranged as usual with for the most part from 4–6 setæ, the first plate of the third sternite as in the female. *Genitalia* (Fig. 89*C*) with the basal plate quite broad; parameres nearly as long as the basal plate, curved and tapering; pseudopenis with the shaft obsolete, the arms curved and slender.

NOTES.—This is an isolated species with no near relatives among the other species of the genus. The peculiar arrangement of the abdominal plates in the female is duplicated only in the otherwise very different *H. biseriata* and the shape of the pleural plates is quite unusual. However, the male is quite of the usual type found in the genus and the character of the legs and of the first pleural plate is typical.

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BIOLOGICAL SCIENCES

VOLUME II NUMBER 3

Contributions Toward a Monograph of the Sucking Lice

PART III.

BY

GORDON FLOYD FERRIS

Assistant Professor of Entomology

STANFORD UNIVERSITY, CALIFORNIA
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1922

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SYSTEMATIC TREATMENT (Cont.)

Genus HOPLOPLEURA Enderlein (Cont.).

Since the publication of Part II [1] of this series I have found in my material two more species of *Hoplopleura*. One of these had been overlooked, the other had mistakenly been set aside as belonging to another genus. The addition of these two species brings the number of forms in the genus to 43. In addition to this material there have come to hand specimens necessitating further notes on one of the species previously dealt with.

37. Hoplopleura emarginata n. sp.

FIGS. 90, 91.

SPECIMENS EXAMINED. Numerous males and females from *Sciurotamias davidianus*, Shensi, China (U. S. N. M. 200873). Holotype a male. The host is a member of the rodent family *Sciuridæ*.

FEMALE (Fig. 90). Length 1.75 mm. *Head* relatively large, acute anteriorly, with slight post-antennal angles and with the posterior-lateral margins but slightly convergent. Anterior portion with a pair of slender, longitudinal, chitinized bars extending to the posterior margin of the antennæ. Ventral side with a pair of small, oval, chitinized areas between the antennæ.

Thorax and legs of ordinary form, the posterior tibiæ without an olecranon process. *Sternal plate* (Fig. 91*B*) large and broad.

Pleural plates (Fig. 91*A*) overlapping but little, not scaly or reticulate; first pair of ordinary form; second with a rather short and stout ventral tooth; third to sixth each with a small tooth at each angle; seventh and eighth very small, without teeth; second to sixth each with two slender setæ, of which the dorsal is quite long; seventh and eighth each with the usual pair of long setæ.

Tergal and sternal plates weakly developed, with for the most part six to ten rather slender setæ, the second plate of the second sternite not extending across the segment and without the usual enlarged, paired setæ. On the dorsal side, between the ends of the tergal plates and the corresponding pleurites of the third to eighth segments, are from one to five stout setæ, and on the ventral side there are from two to four such setæ between the ends of each sternal plate and the pleurites on the fourth to eighth segments.

MALE (Fig. 90). Length 1 mm. *Head and thorax* practically as in the female except the former without the dorsal, longitudinal, chitinized areas and the third antennal segment with a stout seta at the anterior distal angle.

[1] Part II was issued October 14, 1921.

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Pleural plates essentially as in the female. *Tergites* of the abdomen with but one plate except on the second segment, where there are two. The second plate of this segment is emarginate posteriorly and bears three quite

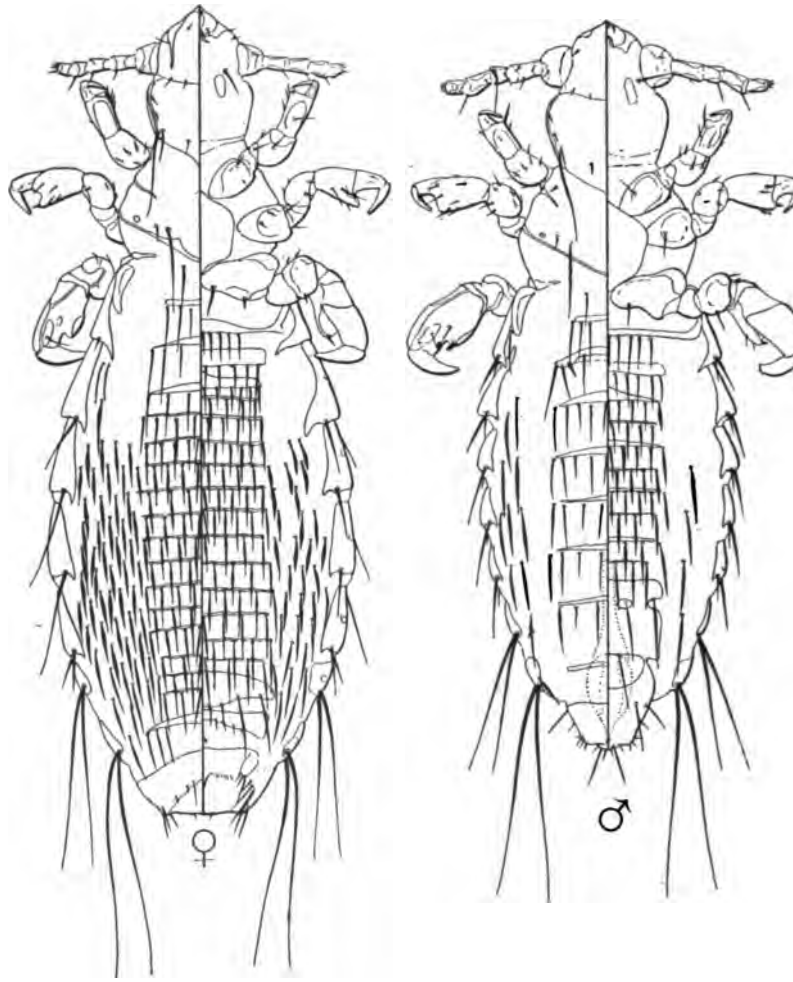

Fig. 90.—*Hoplopleura emarginata* n. sp., male and female.

stout setæ at each end, the remaining plates for the most part bear from six to eight slender setæ, and between the ends of the plates and the corresponding pleurites on the third to seventh segments are from one to three quite stout setæ. *Sternites* with two plates on the second to sixth segments, the second plate of the second segment without enlarged, paired setæ and

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not extending across the segment, the plates with for the most part six to ten setæ. Between the ends of the plates and the corresponding pleurites on the fourth to seventh segments is a single seta.

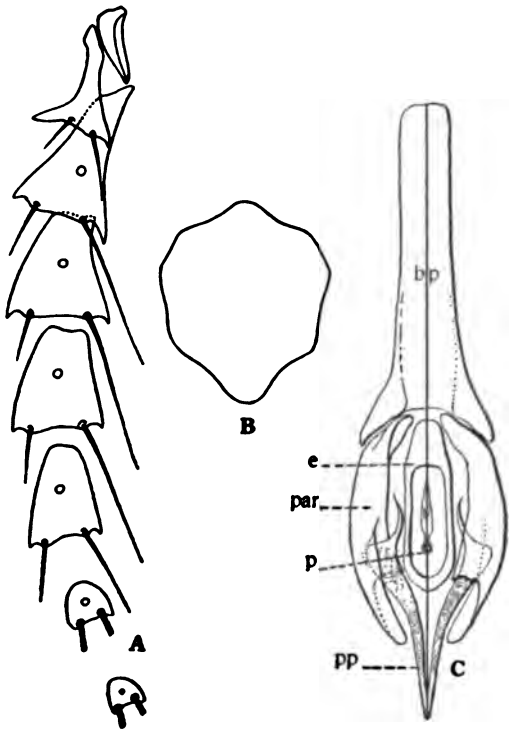

Fig. 91.—*Hoplopleura emarginata* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

Genitalia (Fig. 91*C*), with the basal plate (*bp*) slender, expanded only at the apex; parameres (*par*) stout, receiving the base of the pseudopenis in a deep recess and with a flattened, toothed ventral lobe at some distance from the tip; pseudopenis (*pp*) large, V-shaped, with the arms transversely striate; within the parameres a ring-like piece, the endomeres (*e*) which encloses the penis (*p*).

Notes.—In certain respects, notably the emarginate second tergal plate of the second abdominal segment of the male, the tendency toward a sexual dimorphism in the antennæ and the absence of the paired setæ on the second plate of the second sternite, together with the character of this plate, this species approaches the genus *Neohæmatopinus*. A too hasty conclusion led to its having been set aside as a member of the latter genus, but this is certainly in error. It is undoubtedly a *Hoplopleura* belonging to the *H. erratica* group but easily separable by the characters given.

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38. Hoplopleura ochotonae n. sp.

FIG. 92.

SPECIMENS EXAMINED. Females only. Type from *Ochotona cansus*, Taochao, China (U. S. N. M. 144032). Also from *Ochotona roylei*, Braldu Valley, Baltistan (U. S. N. M.) and *O. danurica*, Tabool, Mongolia (U. S. N. M. 176274).

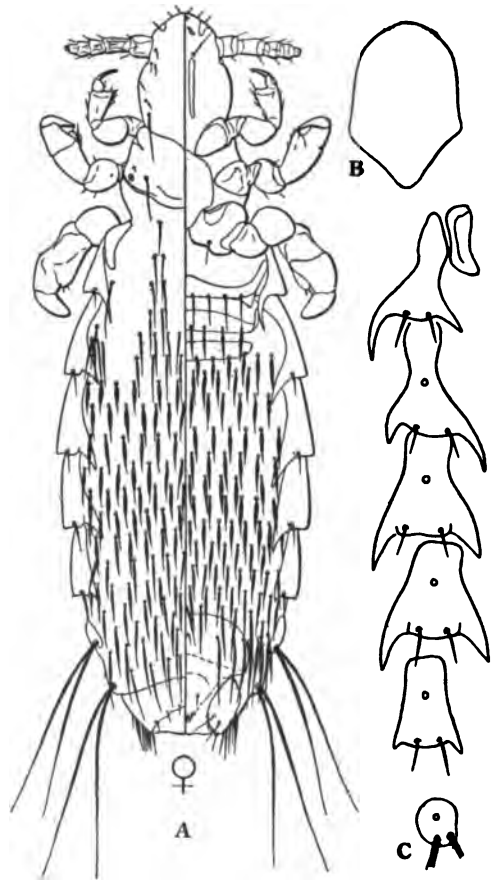

Fig. 92.—*Hoplopleura ochotonæ* n. sp.: *A*, female; *B*, sternal plate; *C*, pleural plates.

FEMALE (Fig. 92*A*). Length 1.3 mm. *Head* rather large, rounded anteriorly and with the lateral margins of the hind head almost parallel; ventral side with a pair of narrow, submedian, chitinized areas.

Thorax and legs of ordinary form, the posterior tibiæ without an olecranon process; sternal plate (Fig. 92*B*) quite large and broad, the anterior

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margin rounded, the lateral margins almost parallel, the posterior margin produced into a point.

Pleural plates (Fig. 92C) as follows: First pair of ordinary form; second with the ventral posterior angle produced into a slender, curved, tapering tooth, the dorsal angle with a shorter tooth; third to fifth pairs with each posterior angle produced into a tapering tooth; sixth with the posterior angles but slightly produced; seventh small; eighth lacking; second to sixth each with a pair of small setæ on the posterior margin; spiracles small.

Tergal and sternal plates not chitinized except for the second sternite and the first two plates of the third sternite. First plate of the third sternite without enlarged, paired setæ. Both dorsally and ventrally there are for the most part ten to fourteen setæ in each row.

MALE. Not known.

NOTES.—This is a somewhat isolated species, resembling most closely the members of the *erratica* group but differing especially in the absence of the paired setæ on the third sternite and in the shape of the sternal plate. The hosts are members of the family *Ochotonidæ*, the "rock rabbits," or "little chief hares," a family that is most closely related to the rabbits.

1a. Hoplopleura acanthopus acanthopus (Burm.) (cont.)

1905. *Polyplax villosa* Galli-Valerio, *Zool. Anz.* **28**: 521–2.
1908. *Polyplax villosa* Galli-Valerio, Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.
1916. *Polyplax villosa* Galli-Valerio, Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 177.

NOTES.—Through the kindness of Dr. Galli-Valerio I have been enabled to examine a male from the type lot of *Polyplax villosa*. The species proves to be a synonym of *Hoplopleura acanthopus*.

Genus **SCHIZOPHTHIRUS** new genus.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; legs with the tibia produced into a thumb-like process opposing the claw, the anterior pair small and weak, with slender claw, the middle pair of the same form as the anterior, but much larger; the posterior pair very stout, with the tarsus flattened and the claw very stout; pleural plates present on the first to eighth segments, the first pair not lying upon the dorsum; female with the fourth to eighth tergites and the fourth to seventh sternites with three rows of setæ; male with the second tergite alone bearing two rows, the remainder with but one; second sternite in both sexes with a large, chitinized plate, which is divided medially and bears two groups of short, stout setæ; head with pronounced post-antennal angles and with a constricted occipital region.

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HOSTS. Occurring on rodents of the families *Muscardinidæ* and *Graphiuridæ*.

TYPE OF THE GENUS. *Pediculus pleurophæus* Burmeister. But one other species, *S. graphiuri* n. sp., is included.

NOTES.—This is a very distinct little genus that I consider to have its nearest relative in the genus *Euhæmatopinus*. In fact, in spite of the peculiar character of the latter, I am inclined to regard the two as really quite closely related. Aside from the reduction of the number of segments in the antennæ and the extraordinary structures of the posterior legs in *Euhæmatopinus*, the two are very similar. More remotely both appear to be related to *Hoplopleura*.

The most distinctive feature common to *Schizophthirus* and *Euhæmatopinus* is that of the character of the second sternal plate of the abdomen. In both genera this plate is much enlarged, is divided medially and has so far encroached upon the third sternite that it appears really to belong to the third segment. This appearance is further heightened by the development upon the second sternite of enlarged setæ such as appear upon the first plate of the third segment in *Hoplopleura*. However, a direct comparison of this region in the two genera leaves no room for doubt as to the true homologies. In Fig. 93 is shown such a comparison of *Schizophthirus graphiuri* n. sp. and *Hoplopleura acanthopus* (Burm.)

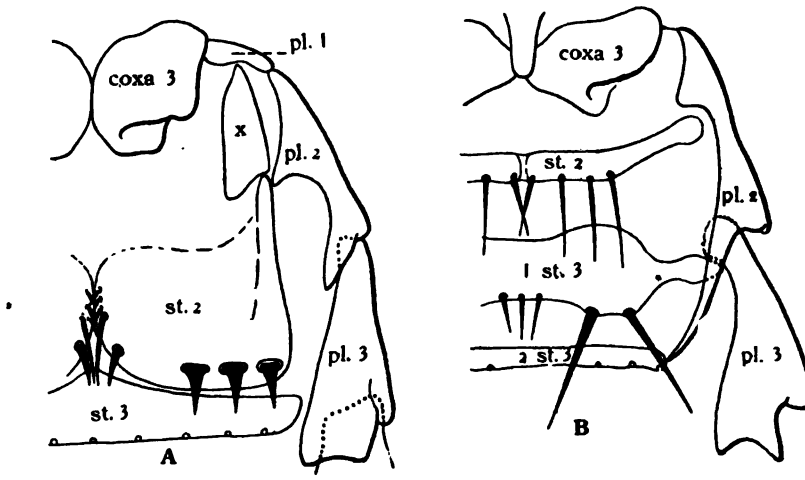

Fig. 93.—Second and third abdominal sternites of: *A*, *Schizophthirus graphiuri* n. sp.; *B*, *Hoplopleura acanthopus* (Burm.).

The two species that I have included under *Schizophthirus* are strikingly different as regards the character of the pleural plates, but nevertheless I do not hesitate to place them in the same genus. They are certainly closely related, and to separate them generically would merely obscure this relationship.

Of the immature stages there are present only examples of the penultimate stage of *S. graphiuri* n. sp. These differ from the adult chiefly in the form of the pleural plates. These are strongly developed but lack the pronounced lobing of the posterior margin that appears in the adult.

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1. **Schizophthirus pleurophaeus** (Burmeister).

FIGS. 94, 95.

1839. *Pediculus pleurophæus* Burmeister, Gen. Rhynchota, No. 7.
1864. *Pediculus pleurophæus* Burm., Nitzsch, *Zeit. f. ges. Naturw.* **23**: 27.
1874. *Hæmatopinus leucophæus* (Burm.), Giebel, "Insecta Epizoa," p. 37.
1880. *Hæmatopinus leucophæus* (Burm.), Piaget, "Les Pediculines," p. 640.
1904. *Polyplax pleurophæa* (Burm.), Enderlein, *Zool. Anz.* **28**: 142.
1908. *Polyplax pleurophæa* (Burm.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 13.
1916. *Polyplax* (?) *pleurophæa* (Burm.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 174.

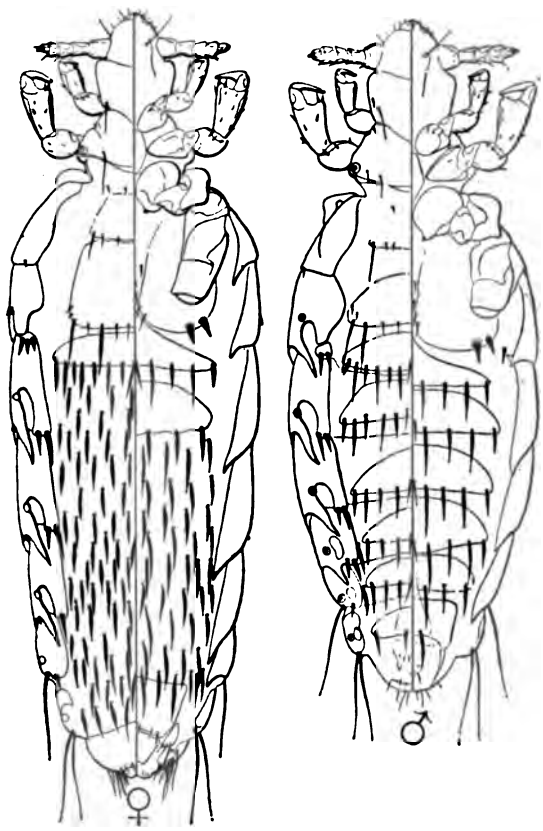

Fig. 94.—*Schizophthirus pleurophæus* (Burm.), male and female.

PREVIOUS RECORDS. From some subspecies of *Eliomys quercinus* (= *Myoxys nitella*), family *Muscardinidæ*, Europe. The only authors who appear to have seen specimens were Burmeister, Nitzsch, and Giebel.

SPECIMENS EXAMINED. From *Eliomys pallidus*, Sorrento, Italy (U. S. N. M. 103031) and *Muscardinus avellanarius*, Wolfsheim, Schlesien, Germany (U. S. N. M. 112908).

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FEMALE (Fig. 94). Length 1.3 mm. *Head* slightly longer than wide, with moderately prominent post-antennal angles. *Thorax* shorter than the head, with the lateral margins strongly angulate; sternal plate (Fig. 95*C*) small, elongate, with the lateral margins angulate; posterior leg (Fig. 95*D*) with the inner, apical angle of the tarsus somewhat produced, acute.

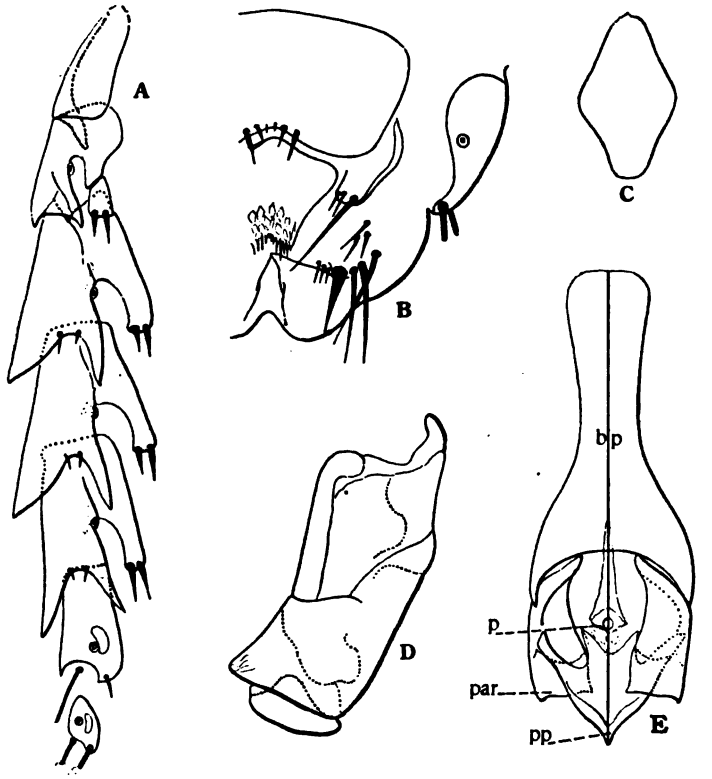

Fig. 95.—*Schizophthirus pleurophœus* (Burm.) : *A*, pleural plates; *B*, genital region of female; *C*, sternal plate; *D*, posterior tibia and tarsus; *E*, genitalia of male.

Pleural plates (Fig. 95*A*) of a very peculiar type. First pair small, not free; second with a tapering ventral process; third to sixth deeply divided into two very unequal parts, the dorsal part slender, truncate, with a pair of short, stout setæ at the apex; the ventral portion again divided by a deep emargination into two tapering lobes and with a pair of small setæ at the base of the emargination; seventh and eighth smaller, without lobes, the seventh with a single long and one small seta, the eighth with two long setæ.

Tergal plates developed only on the second, third, and ninth segments, the second with one plate, the third with two, of which the anterior is

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much the larger, and the ninth with one. Rows of setæ tending to be more or less irregular, for the most part with eight to ten in a row.

Sternal plates developed only on the second to fourth and eighth and ninth segments, those on the eighth and ninth forming the genital plate (Fig. 95*B*). The sternal plate of the second segment is enlarged, as described for the genus, and bears two pairs of short, stout setæ. The third and fourth segments have each a single plate. The rows of setæ are much as on the dorsum. Gonapods (Fig. 95 *B*) very small.

MALE (Fig. 94). Length 1 mm. *Head, thorax and pleural plates* as in the female. *Tergal and sternal plates* strongly developed, arranged as described for the genus, for the most part with eight to ten setæ. *Genitalia* (Fig. 95*E*) with the basal plate (*bp*) expanded posteriorly; parameres (*par*) much flattened; penis (*p*) borne at the tip of a slender statumen penis; pseudopenis (*pp*) very small, broadly V-shaped.

NOTES.—From the only other species of the genus, *S. graphiuri* n. sp., this differs most strikingly in the remarkable form of the pleural plates. The redescription is based upon specimens from *Eliomys quercinus.*

2. Schizophthirus graphiuri n. sp.

FIGS. 93*A*, 96, 97.

SPECIMENS EXAMINED. Holotype, a female, and allotype from *Graphiurus murinus isolatus,* Mt. Mbololo, British East Africa (U. S. N. M. 182834). Also from *Graphiurus raptor,* Mt. Kenia, British East Africa (U. S. N. M. 164265), and *G. nanus,* Mtabamhlope, Natal (Lawrence Hill).

FEMALE (Fig. 96). Length 1.4 mm. *Head* but slightly longer than broad, with prominent post-antennal angles and with the lateral margins of the hind head somewhat convergent. *Thorax* shorter than the head, with the lateral margins somewhat angulate; sternal plate (Fig. 97*D*) elongate oval; middle legs strikingly large and long; posterior legs with the inner apical angle somewhat produced and acute.

Pleural plates (Fig. 97*A*) as follows: first pair very small; second with a short ventral process; third to seventh each divided by a shallow emargination into two broad lobes with rounded or obtuse angles; eighth with but the dorsal lobe present; second to sixth each with a pair of small setæ in the emargination; seventh with one small and one long seta, eighth with two long setæ.

Tergal plates developed on the second, third, and ninth segments, the second segment with two plates, the others with one. Rows of setæ very irregular, for the most part with six to ten setæ. *Sternal plates* developed on the second, third, and eighth segments, each with one plate. Sternal plate of the second segment (Fig. 93*A*) with two groups of three enlarged setæ. Rows of setæ much as on the dorsum. Gonapods (Fig. 97*C*) very small.

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MALE (Fig. 96). Length 1.1 mm. *Head, thorax, and pleural plates* as in the female. *Tergal and sternal plates* strongly developed, arranged as described for the genus, for the most part with ten or more setæ. *Geni-*

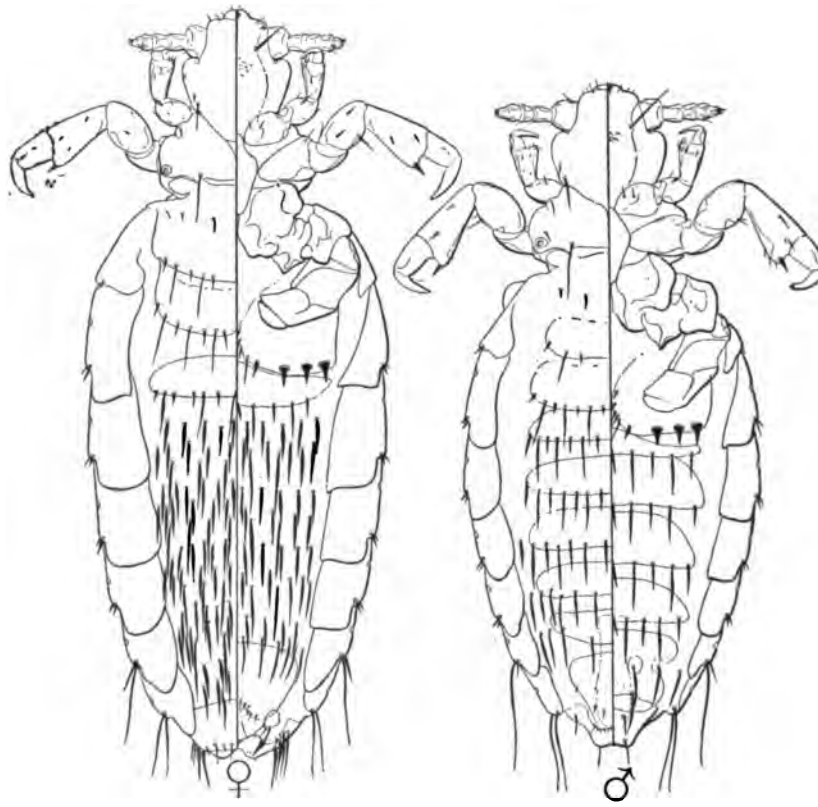

Fig. 96.—*Schizophthirus graphiuri* n. sp., male and female.

talia (Fig. 97*B*) with the basal plate (*bp*) quite broad, not expanded posteriorly, parameres (*par*) curved, flattened at the tips; penis (*p*) borne at the tip of an expanded statumen penis; pseudopenis (*pp*) very small, V-shaped.

NOTES.—The character of the pleural plates distinguishes this sharply from the other species of this genus, *S. pleurophæus* (Burm.)

Genus **EUHÆMATOPINUS** Osborn.

1896. Osborn, *U. S. Dept. Agric., Div. Ent., Bull.* (*n. s.*) **5**: 186.
1904. Enderlein, *Zool. Anz.* **28**: 140.
1908. Dalla Torre, "Anoplura," *Gen. Ins.*, p. 16.
1915. Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.*, p. 46.
1916. Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 179.

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Anoplura without eyes; with four-segmented antennæ, which appear superficially as three-segmented and which are not sexually dimorphic; legs with the tibia produced into a thumb-like process opposing the claw, the first pair small and weak, the second of the same form as the first but much larger, the third with the tarsus much flattened and with a membranous appendage arising from the femur and the tibia; pleural plates present on the first to eighth segments, the first pair not lying upon the dorsum; female with two rows of setæ on the third to seventh tergites and the fourth sternite of the abdomen, the male with two rows ot setæ on the third tergite only, the remaining tergites and sternites with but one; second sternal plate in both sexes enlarged, divided medially; head with distinct post-antennal angles and with the occipital region slightly constricted.

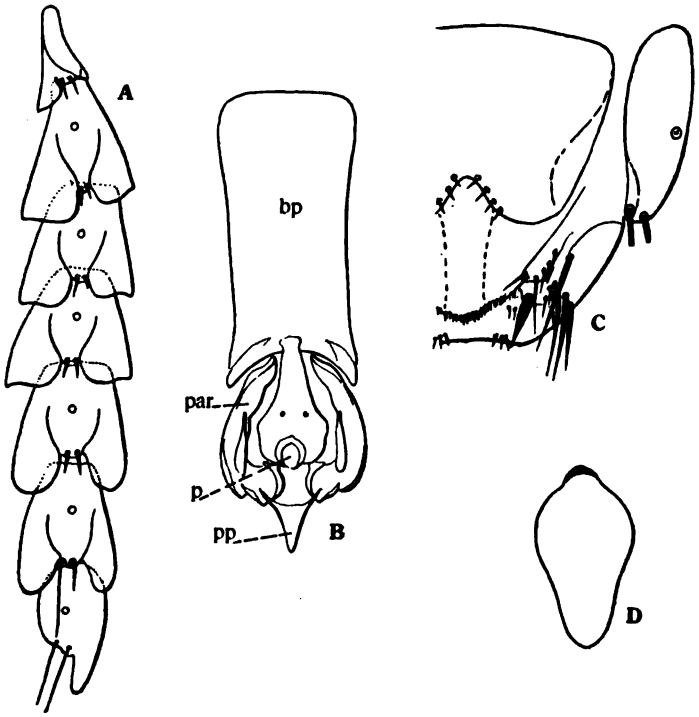

Fig. 97.—*Schizophthirus graphiuri* n. sp.: *A*, pleural plates; *B*, genitalia of male; *C*, genital area of female; *D*, sternal plate.

Hosts. Occurring as far as known only on insectivores of the genus *Scalopus*, the "moles," in North America.

Type of the Genus. *Euhæmatopinus abnormis* Osborn. This is the only included species.

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NOTES.—As I have pointed out under the discussion of *Schizophthirus,* I regard these two genera as quite closely related, in spite of the peculiar characters of *Euhæmatopinus.*

The antennæ in this genus have heretofore been described as three-segmented, but in well-stained preparations it is evident that they are really four-segmented. The curious, swollen, membranous appendages on the posterior legs are quite unique. They appear simply as membranous expansions arising from the femur and tibia. I am not prepared at present to discuss at length the systematic position of the genus, but I may note that I am not inclined to give it any such isolated position as has heretofore been accorded it.

As has previously been pointed out (Kellogg and Ferris, ref. cited), the genus *Euhæmatopinus* is in all probability a synonym of *Hæmatopinoides* Osborn, and *E. abnormis* is probably a synonym of *H. squamosus* Osborn. The description given for *Hæmatopinoides squamosus* applies exactly to *Euhæmatopinus abnormis,* excepting only for the character of the posterior legs, which in *Hæmatopinoides* are not described as having the membranous appendages. Even though the two species were described by the same author, it appears highly probable that an error was made. The types of *Hæmatopinoides squamosus* are said to have been lost, and the matter can not now be settled.

1. Euhæmatopinus abnormis Osborn.

FIGS. 98, 99.

1896. *Euphæmatopinus abnormis* Osborn, *U. S. Dept. Agric., Div. Ent., Bull.* (*n. s.*) **5**: 187.
1904. *Euhæmatopinus abnormis* Osborn, Enderlein, *Zool. Ans.* **28**: 140.
1908. *Euhæmatopinus abnormis* Osborn, Dalla Torre, "Anoplura," *Gen. Ins.,* p. 16.
1915. *Euhæmatopinus abnormis* Osborn, Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.,* p. 47; tf. 16; pl. 3, f. 3; pl. 5, f. 4, 9.
1916. *Euhæmatopinus abnormis* Osborn, Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 179.

PREVIOUS RECORDS. From *Scalopus aquaticus machrinus* (= *Scalops argentatus*), Ames, Iowa, U. S. A.

SPECIMENS EXAMINED. From *Scalopus aquaticus machrinus,* Illinois (U. S. N. M. 19616); *S. aquaticus machrinoides,* Elk River, Minnesota (U. S. N. M. 67601); and Ft. Leavenworth, Kansas (U. S. N. M. 91588); "mole," Rochester, New York. I have previously examined the types.

FEMALE (Fig. 98). Length 1.3 mm. *Head* (Fig. 99*D*) elongate, pointed anteriorly, with small post-antennal angles and a somewhat constricted occipital region. Antennæ (Fig. 99*C*) with a large sensorium on the third segment, the third and fourth segments appearing superficially as a single segment.

Thorax shorter than the head, with the lateral margins arcuate; sternal plate (Fig. 99*F*) oval, pointed posteriorly. Posterior legs (Fig. 99*B*) scarcely reaching beyond the margin of the body.

Pleural plates (Fig. 99*G*) strongly developed; first pair very small; second with a tapering ventral process; third to sixth with the posterior

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margin divided into two rounded lobes with a smaller lobe between, the middle lobe bearing a pair of small setæ; seventh and eighth without lobes, each with two slender setæ; spiracles small.

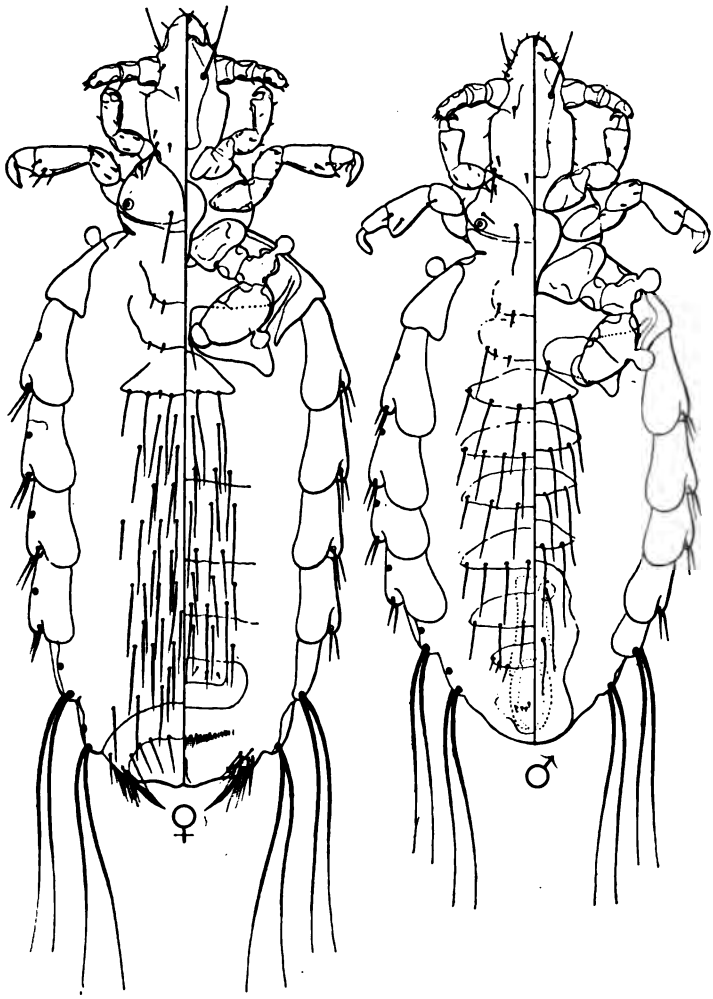

Fig. 98.—*Euhæmatopinus abnormis* Osborn, male and female.

Tergal plates weakly developed, the second segment with one, the third with two, and the ninth with one. Setæ small, slender, for the most part six to eight in a row. *Sternal plates* developed only on the second, third, and eighth segments, each with one. Sternite of the second segment without enlarged setæ. Setæ of the ventral side arranged much as on the dor-

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sum. Gonapods apparently lacking; ninth segment (Fig. 99*H*) with a cluster of slender setæ near the lateral margins beneath and with a large, flattened seta at each apical angle.

MALE (Fig. 98). Length 1 mm. *Head, thorax, and pleural plates* as in the female. *Tergal and sternal plates* quite strongly developed, arranged as described for the genus, with for the most part four to eight setæ. *Genitalia* (Fig. 99*A*) with the basal plate (*bp*) broad, not expanded pos-

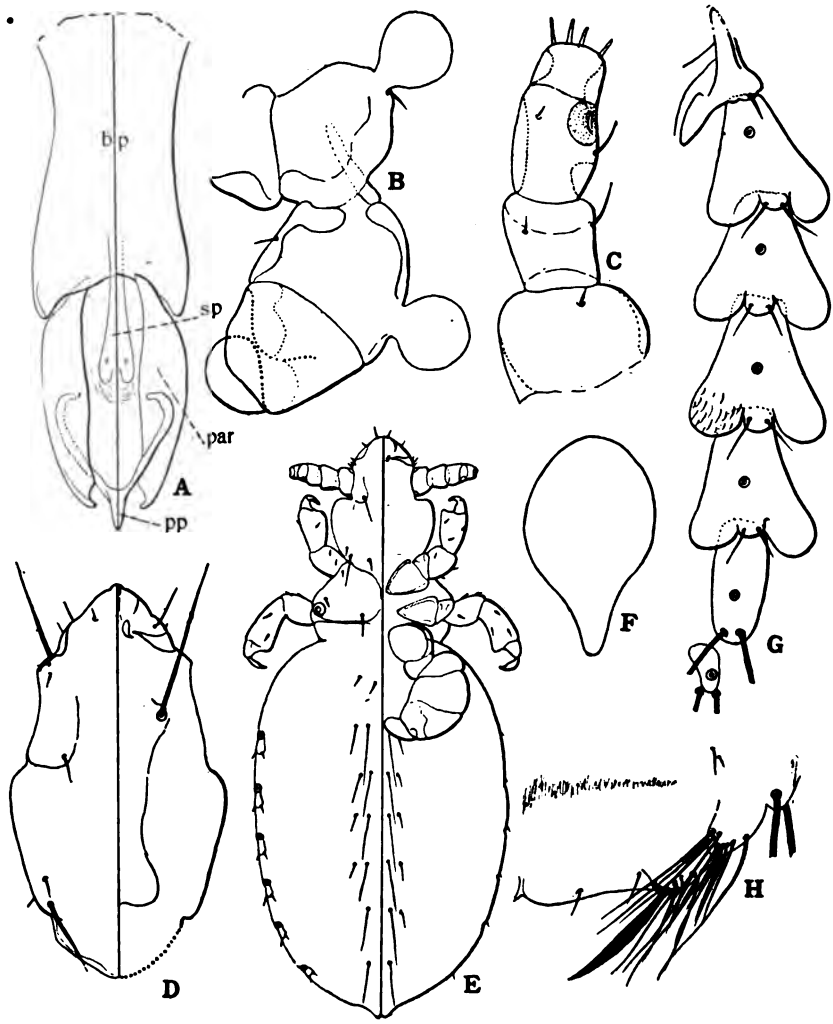

Fig. 99.—*Euhæmatopinus abnormis* Osborn: *A*, genitalia of male; *B*, posterior leg; *C*, antenna; *D*, head; *E*, immature stage; *F*, sternal plate; *H*, ventral side of ninth abdominal segment.

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teriorly; parameres (*par*) elongate, somewhat flattened, enclosing the slender statumen penis (*sp*); pseudopenis Y-shaped, with the shaft quite short.

IMMATURE STAGE. A single immature stage is represented in my material, this possibly being of the second instar (Fig. 99*E*). The antennæ and legs are as in the adult, except that the appendages of the posterior pair of legs are lacking. The tergal and sternal plates are undeveloped. The pleural plates are present on the third to eighth segments but are extremely small.

Genus **CTENOPHTHIRUS** new genus.

Anoplura without eyes; with five-segmented antennæ, which are not sexually dimorphic; legs with the tibia produced into a thumb-like process opposing the claw, the anterior pair small and weak, the middle and posterior pairs much larger, with the tarsus somewhat flattened and with stout claw; pleural plates present on the second to eighth segments; female with three plates and three rows of setæ on the fourth to sixth tergites and third to sixth sternites, two plates and two rows of setæ on the second, seventh, and eighth tergites and seventh and eighth sternites, the posterior row of setæ on the third to eighth tergites and third to sixth sternites much flattended and expanded and arranged in a comb-like series; male with two rows of setæ on the third tergite and the third to seventh sternites and one on the remainder, the setæ of the posterior row in each case, expanded as in the female; genitalia of male with no specially distinctive characters.

HOSTS. Known only from a single species of the rodent family *Octodontidæ*.

TYPE OF THE GENUS. *Ctenophthirus cercomydis* n. sp.

NOTES.—The rows of flattened setæ are the most distinctive character of this genus. Taken by themselves they would hardly be sufficient to justify its separation from *Polyplax* or *Hoplopleura*, but taken in conjunction with the other characters given the establishment of the genus appears to be justified. It is possibly most closely related to *Polyplax*.

1. **Ctenophthirus cercomydis** n. sp.

FIGS. 100, 101.

SPECIMENS EXAMINED. Several males and females from *Cercomys fosteri*, Sapucay, Paraguay (U. S. N. M. 121408). Holotype a female.

FEMALE (Fig. 100). Length 1.6 mm. *Head* (Fig. 101*A*) slightly longer than broad, truncate anteriorly, with slight post-antennal angles and without a constricted occipital region; ventral side and first segment of antennæ with a number of small, sharp, backward-pointing tubercles.

Thorax about as long as the head and but slightly wider, with the lateral margins slightly arcuate; sternal plate (Fig. 101*D*) broad, somewhat shield-shaped with the apex anteriorly; legs as described for the genus.

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Pleural plates (Fig. 101*G*) as follows: first pair lacking; second small, quadrate, with a pair of setæ on the posterior margin; third to sixth narrow, elongate, with the posterior angles produced into small teeth and with a pair of large, stout setæ on the posterior margin; seventh and eighth with large setæ but without teeth.

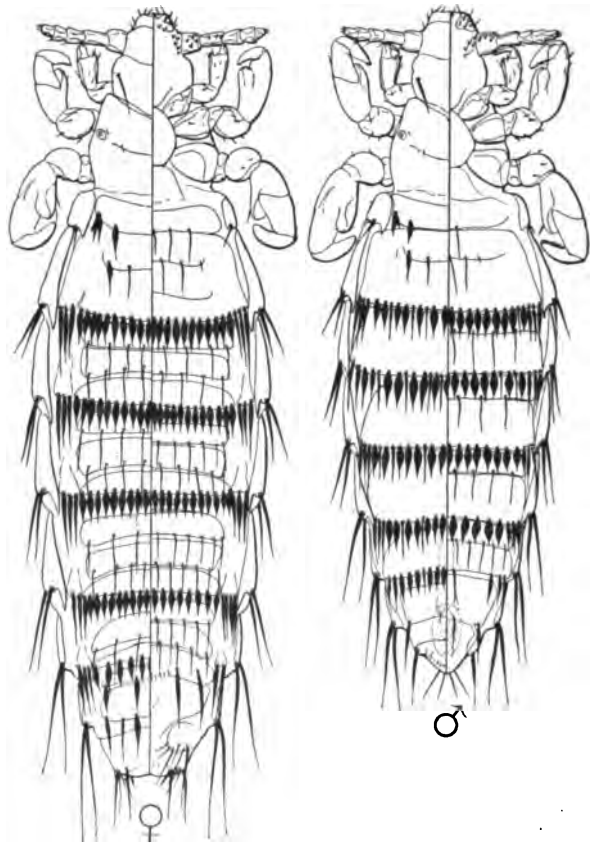

Fig. 100.—*Ctenophthirus cercomydis* n. sp., male and female.

Tergal and sternal plates well developed; posterior row of each segment for the most part with as many as twenty flattened setæ (Fig. 101*B*, *C*) the others with but six to ten small, slender setæ. Between the ends of the last plate and the corresponding pleurite on the third to seventh segments, both dorsally and ventrally, there is a small, detached plate bearing three or four moderately stout setæ. Spiracles small. Gonapods (Fig. 101*F*) apparently lacking.

MALE (Fig. 100). Length 1.5 mm. *Head, thorax, and pleural plates* as in the female. *Tergal and sternal plates* strongly developed, the anterior

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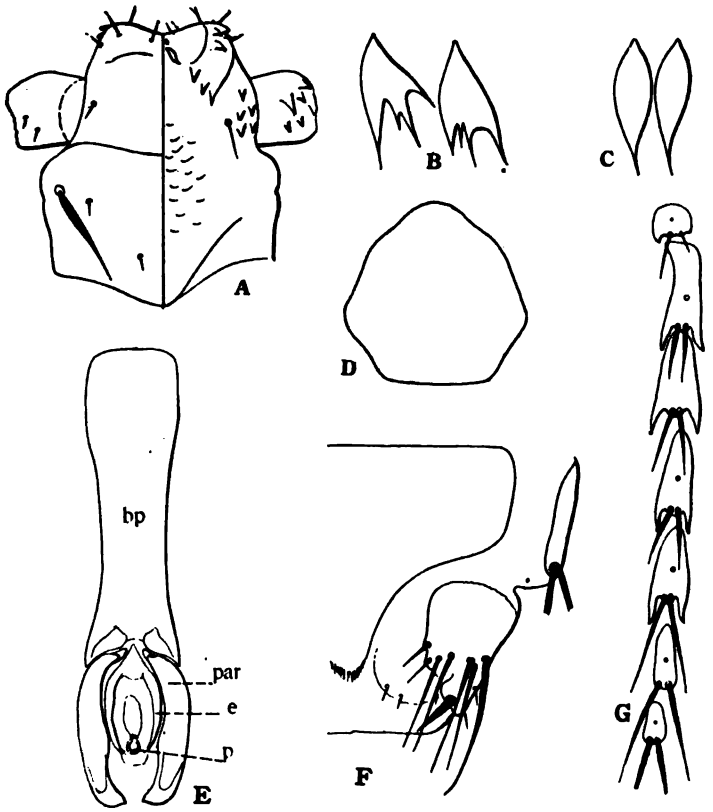
te of each sternite much smaller than the posterior, and with very small e. The isolated plates, between the ends of the tergal and sternal plates, l the pleurites, seen in the female, are lacking.



. 101.—*Ctenophthirus cercomydis* n. sp.: *A*, head; *B*, setæ from second tergite; *C*, setæ from third tergite; *D*, sternal plate; *E*, genitalia of male; *F*, genital region of female; *G*, pleural plates.

Genitalia (Fig. 101*E*) with the basal plate (*bp*) quite long, not exnded posteriorly, the parameres (*par*) quite stout, slightly curved, enclos- ; a ring-like piece, which appears to be composed of the fused endomeres), and the penis (*p*). The pseudopenis appears to be lacking.

Immature Stages. A single specimen, representing possibly the secd stage, is present in my material. This specimen is damaged, the legs ng broken off, but is here figured (Fig. 102) as completely as possible. ıe head (Fig. 102*B*) is very much as in the adult. The abdomen (Fig. 2*A*) is entirely membranous and bears setæ only on the last four segnts, the last segment, which is heavily chitinized, having a single seta at

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each lateral margin and the others a pair of setæ. The penultimate segment likewise bears a median pair of dorsal setæ which are probably quite large, but are broken in my specimen.

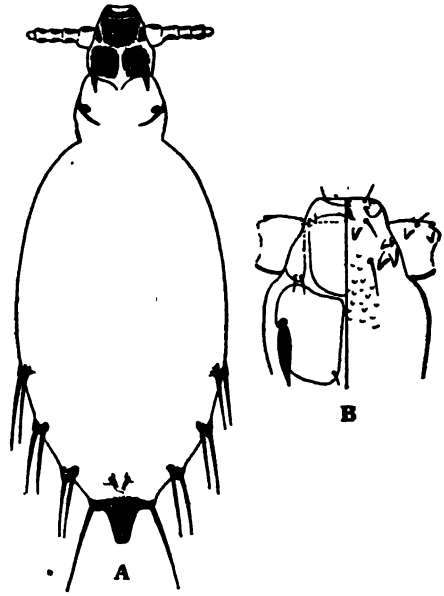

Fig. 102.—*Ctenophthirus cercomydis* n. sp.: *A*, immature stage; *B*, head of same.

Genus **RATEMIA** Fahrenholz.

1916. Fahrenholz, *Archiv f. Naturgeschichte*, Abt. A, 81, 11: 31.

Anoplura without eyes; with five-segmented antennæ; legs with the tibia produced into a thumb-like process opposing the claw, the anterior pair moderately small, middle and posterior legs of much the same form as the anterior pair but somewhat larger; pleural plates present on the fourth to sixth segments; tergal and sternal plates undeveloped except for the ninth tergite and the genital plate on the eighth sternite, the abdomen membranous, the segments, both dorsally and ventrally either with a confused group of setæ or with a single row which merges medially into an irregular group; head without distinct post-antennal angles but with a constricted occipital region.

Hosts. Unknown.

Type of the Genus. *Hæmatopinus* (*Linognathus*) *squamulatus* Neumann. This is the only included species.

Notes.—This is a peculiar genus of somewhat doubtful affinities. It is possibly related to the forms now placed under *Linognathoides* rather than to *Linognathus* as was suggested by Neumann. The number of pleural plates is perhaps the most distinctive character.

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1. Ratemia squamulata (Neumann).

FIG. 103.

1911. *Hæmatopinus* (*Linognathus*) *squamulatus* Neumann, *Archives de Parasitologie* 14: 401; f. 1–4.

1916. *Hæmatopinus* (*Linognathus*) (?) *squamulatus* Neumann, Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 179.

1916. *Ratemia squamulatus* (Neum.), Fahrenholz, *Archiv f. Naturgeschichte*, Abt. A, 81,11: 31.

PREVIOUS RECORDS. Known only from the original record, from unknown host, Dire-Daoua, Abyssinia.

SPECIMENS EXAMINED. A single female co-type, received through the kindness of Dr. A. Martin of the Ecole Veterinaire of Toulouse.

FEMALE (Fig. 101*A*). Length 6.1 mm. *Head* relatively small, acute anteriorly, slightly swollen behind the antennæ and with the occipital region sharply constricted. Antennæ (Fig. 101*C*) without distinctive characters.

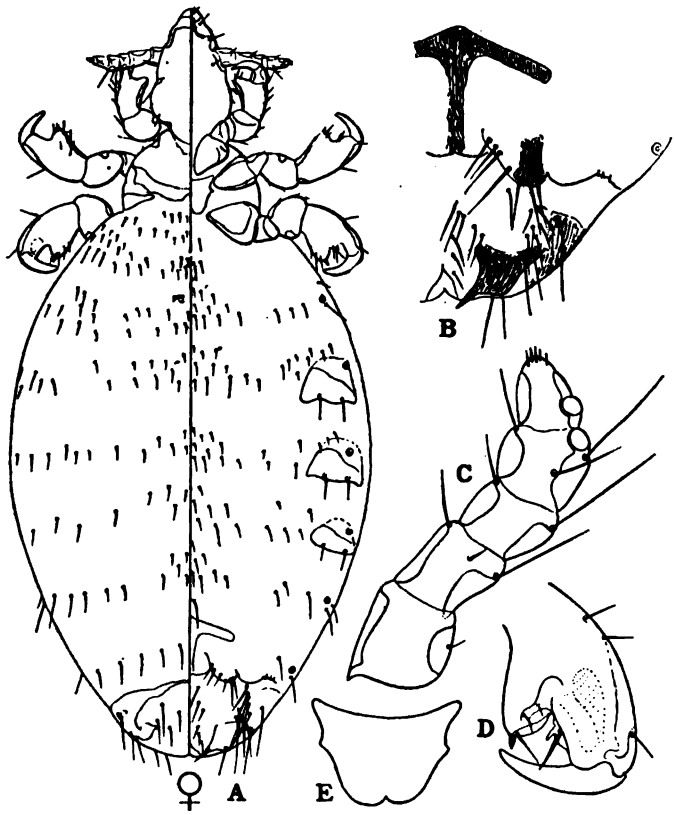

Fig. 103.—*Ratemia squamulata* (Neum.): *A*, adult female; *B*, genital region; *C*, antenna; *D*, tibia and tarsus of posterior leg.

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Thorax likewise relatively small, shorter than the head, with the lateral margins strongly arcuate, the whole nearly semicircular in form; dorsum with a strong, transverse chitinized ba ; sternal plate (Fig. 101*E*) quite broad.

Pleural plates roughly rectangular, [illegible] margin nearly straight and bearing two small setæ. Dorsally [illegible] second segment is quite thickly beset with small setæ; the third bears an irregular transverse group, the fourth to seventh each bear a transverse row which merges medially into an irregular group; the eighth bears a single transverse row. On the ventral side the arrangement is much the same except that the second segment bears but few setæ. *Genital plate* (Fig. 101*B*) T-shaped; gonapods small; ninth segment with a pair of flattened lobes each bearing a small, stout seta.

MALE. Unknown.

Genus **FAHRENHOLZIA** Kellogg and Ferris.

1915. Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.*, p. 32.

1916. Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 150.

Anoplura without eyes; with five-segmented antennæ, which are not sexually dimorphic; legs with the tibia produced into a thumb-like process opposing the claw, the anterior pair small and weak, the middle and posterior pairs much larger, subequal, with the tarsus flattened and bearing a tooth-like process at the outer basal angle and with the claw stout; pleural plates present on a variable number of segments beginning with the second, the second pair divided longitudinally into two parts, one of which lies upon the dorsum, the other on the venter; abdomen in both sexes almost entirely membranous, with a single transverse row of large setæ on each segment, both dorsally and ventrally; head relatively small, with very slight or no post-antennal angles and without a constricted occipital region.

HOSTS. Occurring as far as known only on rodents of the family *Heteromyidæ*, the "jumping" or "kangaroo" rats and mice. This is a small family that is confined to the western hemisphere.

TYPE OF THE GENUS. *Fahrenholzia pinnata* Kellogg and Ferris.

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS:

pinnata Kellogg and Ferris.
tribulosa Ferris.
tribulosa Ferris (part).
Fahrenholzia tribulosa reducta n. ssp.

NOTES.—The members of this genus, like the members of their host family, constitute a small and isolated group. With the three new forms herein described there are but five forms in the genus, and it is not probable that the number will be very greatly increased. The position of the genus is doubtful, and I am not prepared to discuss this point until the entire Order has been reviewed. The most distinctive char-

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acter lies in the divided pleural plates of the second segment. I may note that in most of the species of *Polyplax* there is a strong tendency in the direction of a similar division of this pair of plates, although the two genera are certainly sufficiently distinct otherwise.

Of the immature forms I have seen only examples representing the penultimate stage. This stage (Fig. 107*E*) is practically the same in all the species, differing from the adult in the almost complete absence of setæ, except for the long marginal setæ on the penultimate and ante-penultimate segments and on the pleural plates.

1. Fahrenholzia pinnata Kellogg and Ferris.

FIGS. 104, 105.

1915. *Fahrenholzia pinnata* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mam.," *Stanford Univ. Publ.*, p. 32; tf. 13; pl. 3, f. 2; pl. 5, f. 5; pl. 6, f. 10.

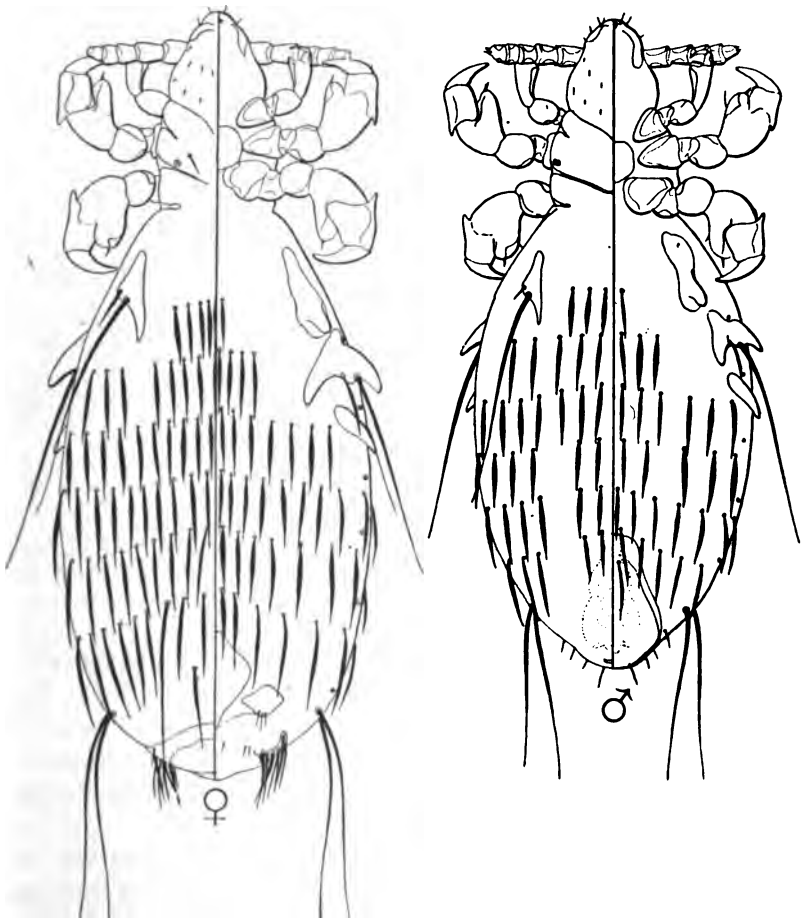

Fig. 104.—*Fahrenholzia pinnata* Kellogg and Ferris, male and female.

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1916. *Fahrenholzia pinnata* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 150.

1916. *Fahrenholzia pinnata* K. and F., Ferris, *Psyche* 23: 102.

PREVIOUS RECORDS. Type from *Dipodomys californicus,* Covelo, California. Recorded by Ferris from the following hosts and localities, all in California: *Dipodomys merriami cimiolus,* Independence; *D. deserti,* Mecca; *Perodipus* sp., Coulterville; *Microdipodops polionotus,* Benton; and from *Perognathus parvus olivaceous,* Pine Forest Mountains, Nevada.

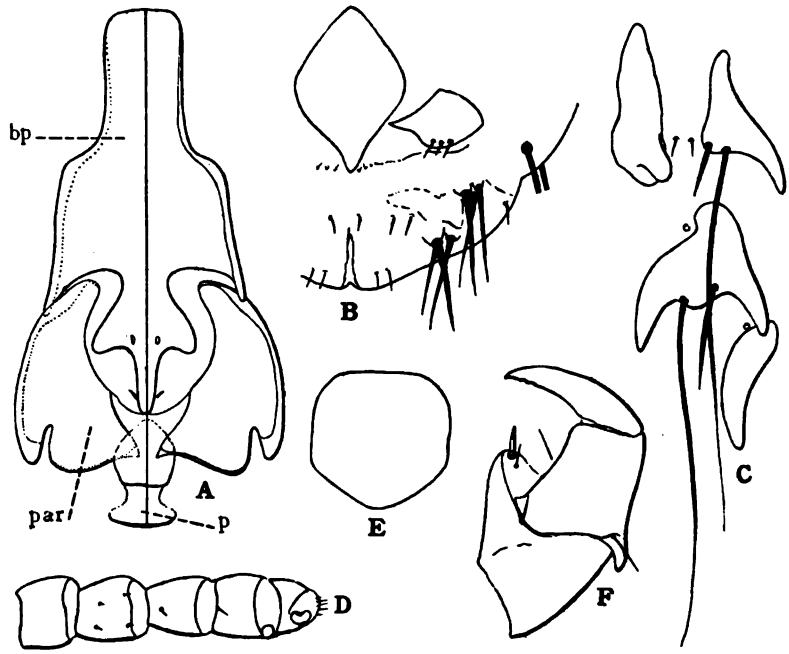

Fig. 105.—*Fahrenholzia pinnata* Kellogg and Ferris: *A*, genitalia of male; *B*, genital region of female; *C*, pleural plates; *D*, antenna; *E*, sternal plate; *F*, posterior tibia and tarsus.

SPECIMENS EXAMINED. All those upon which the above records are based and the following: *Dipodomys phillipsi,* Amecameca, Mexico (U. S. N. M. 52036); *D. ornatus,* Valparaiso, Zacatecas, Mexico (U. S. N. M. 91939); *D. deserti,* Ludlow, California (U. S. N. M. 136616); *D. merriami nevadensis,* Pahrump Valley, Nevada (U. S. N. M. 26053; *Perodipus richardsoni,* Alva, Oklahoma (F. C. M. 6807).

FEMALE (Fig. 104). Length 1.1 mm. *Head* slightly longer than wide, acute anteriorly. *Thorax* about as long and but little wider than the head, with the lateral margins nearly straight and parallel; sternal plate (Fig. 105*E*) roughly pentagonal.

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Pleural plates (Fig. 105*C*) present on but the second to fourth segments; those of the second segment divided as characteristic of the genus, both the parts rather slender, the dorsal part consisting of a single, curved lobe, the ventral part an elongated, slender piece with a small, free lobe; between the two parts are two small setæ, and the dorsal part bears one very long and one short seta; plates of the third segment quite large, roughly triangular with the apical angles produced into tapering lobes and with a pair of long setæ on the posterior margin; plates of the fourth segment consisting merely of a curved, tapering lobe with the apex free.

Abdomen with the setæ all quite large and stout; second tergite with about ten, third to seventh with as many as twenty, the eighth with two; eighth segment with a pair of long setæ at each lateral margin; ninth with a chitinized tergal plate. On the ventral side the setæ are arranged much as on the dorsum. *Genital plate* (Fig. 105*B*) quite large; gonapods with but two or three small setæ, lateral margins of the ninth segment with two clusters of moderately large setæ.

MALE (Fig. 104). Length 0.9 mm. *Head, thorax, and pleural plates* as in the female. *Abdomen* with the number of setæ somewhat smaller than in the female. *Genitalia* (Fig. 105*A*) with the basal plate (*bp*) sharply and strongly expanded at about its middle and with a trident-shaped median posterior prolongation; parameres (*par*) much flattened; pseudopenis (*pp*) strongly reduced; penis not evident.

NOTES.—The form of the pleural plates permits the separation of this from *F. microcephala* n. sp., which has somewhat similar genitalia, and the form of the genitalia distinguishes it from *F. tribulosa zacatecæ* n. ssp., which has somewhat similar pleural plates.

2. Fahrenholzia microcephala n. sp.

FIGS. 106, 107.

SPECIMENS EXAMINED. Holotype, a male, and allotype from *Heteromys pictus obscurus,* San Carlos, Vera Cruz, Mexico (F. C. M. 11099). Also from *Heteromys goldmani,* Achotal, Vera Cruz, Mexico (U. S. N. M. 14353); *Liomys irroratus jalicensis,* Atamejac, Jalisco, Mexico (U. S. N. M. 34131); *L. irroratus canus,* Valparaiso, Zacatecas, Mexico (U. S. N. M. 91883); *L. texensis,* Brownsville, Texas (U. S. N. M. 29943).

FEMALE (Fig. 106). Length 1.4 mm. *Head* (Fig. 107*D*) relatively very short, slightly broader than long. *Thorax* slightly longer than the head and but little broader, with the lateral margins practically parallel; sternal plate (Fig. 107*C*) somewhat hatchet-shaped.

Pleural plates (Fig. 107*A*) strongly developed, present on the second to fourth segments; first pair with the dorsal portion bearing one very long and one minute seta, terminating in a single tapering lobe and with the ventral portion terminating in a broad, free lobe; between the two parts

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are a pair of very small setæ; plates of the third segment with a broad, nearly truncate dorsal lobe and a tapering, curved ventral lobe which bears one very long and one shorter seta; plates of the fourth segment consisting of a single long, tapering lobe.

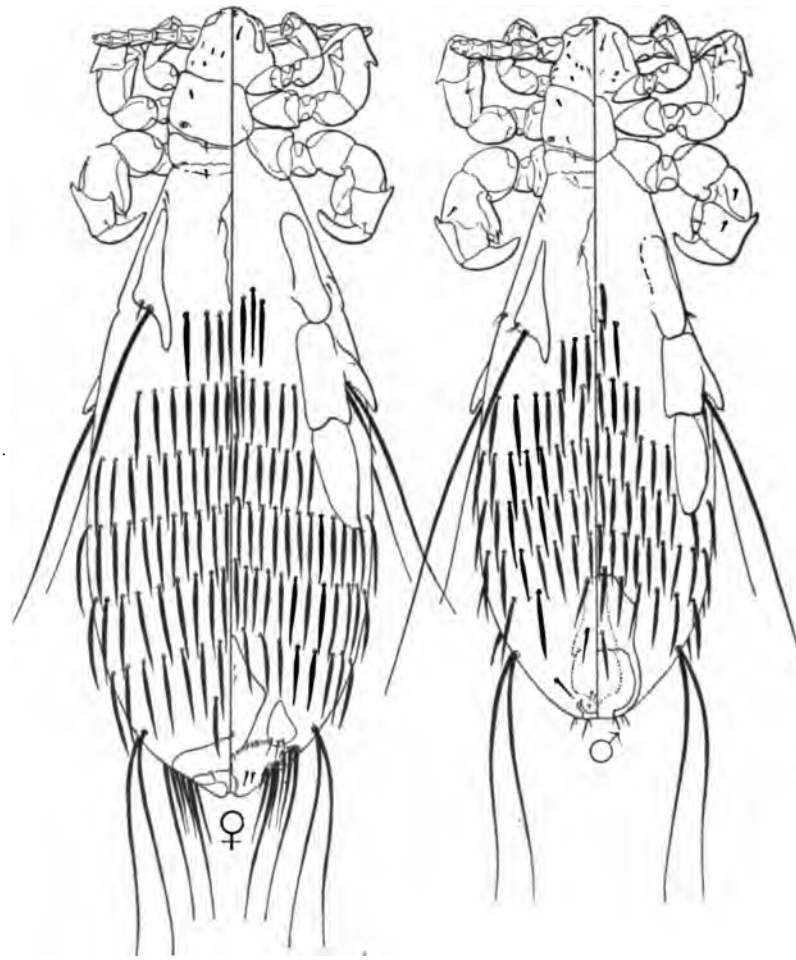

Fig.106. *Fahrenholzia microcephala* n. sp., male and female.

Abdomen with a narrow, longitudinal, chitinized area on the second tergite and a transverse plate on the ninth tergite; second tergite with six or seven setæ, third to seventh with thirteen to twenty, the eighth with but two. Ventral side with the setæ arranged much as on the dorsum. Genital plate quite large. Margins of the ninth segment with two clusters of setæ, some of which are very long.

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MALE (Fig. 106). Length 1.1 mm. In general closely resembling the female. *Genitalia* (Fig. 107*B*) with the basal plate (*bp*) quite broad, with the apical angles produced and with a slender, median, posterior process; parameres (*par*) with the tips flattened and expanded; pseudopenis (*pp*) a short, straight rod with the posterior end slightly trifoliate.

NOTES.—The unusual character of the pleural plates is sufficient to distinguish this species from the others of the genus.

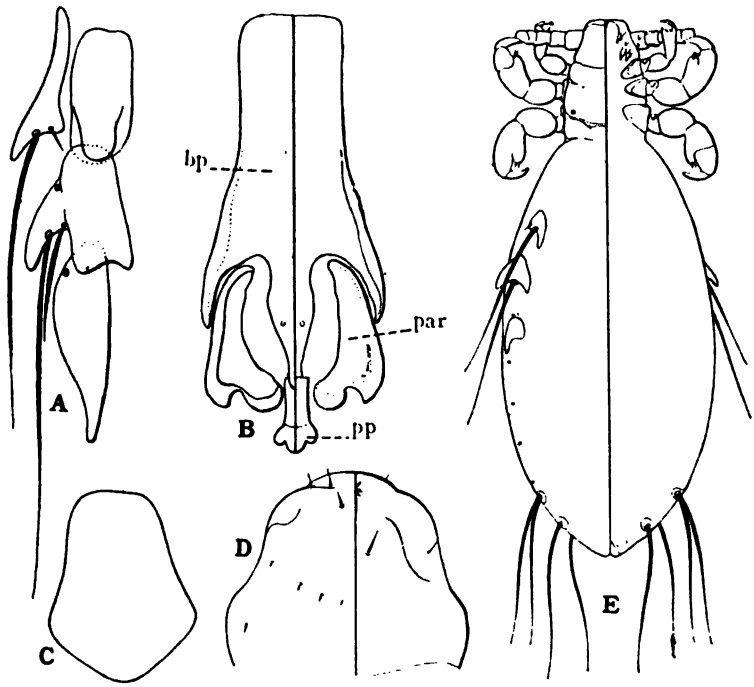

Fig. 107.—*Fahrenholzia microcephala* n. sp.: *A*, pleural plates; *B*, genitalia of male; *C*, sternal plate; *D*, head; *E*, immature stage.

3. Fahrenholzia tribulosa Ferris.

(Synonymy under subspecies.)

3a. Fahrenholzia tribulosa tribulosa Ferris.

FIGS. 108, 109*A*, 109*D*, 109*E*.

1916. *Fahrenholzia tribulosa* Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 151 (part; without description).

1916. *Fahrenholzia tribulosa* Ferris, *Psyche* **23**: 102; f. 4, 5 (part).

PREVIOUS RECORDS. Type, a female, and allotype from *Perognathus californicus*, Pleasant Valley, California. Specimens from *Perognathus formosus*, Victorville, California, previously recorded as belonging to this form are now transferred to *F. tribulosa reducta* n. ssp.

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SPECIMENS EXAMINED. Only as above.

FEMALE (Fig. 108). Length 1.4–1.5 mm. *Head* a trifle longer than broad, acute anteriorly. *Thorax* about as long as the head and scarcely wider, with the lateral margins nearly parallel; sternal plate (Fig. 109*E*) roughly circular.

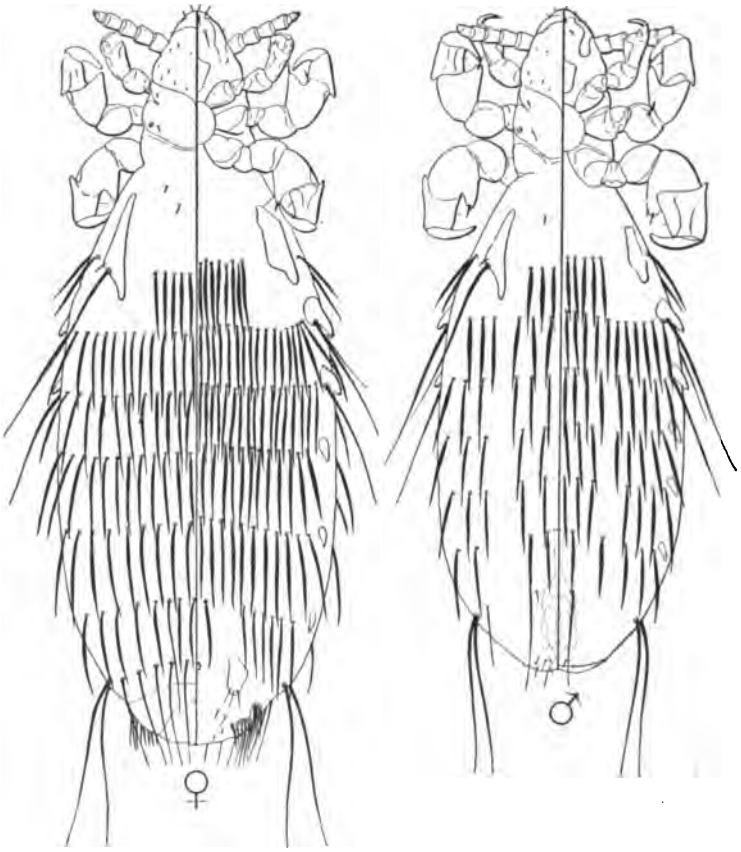

Fig. 108.—*Fahrenholzia tribulosa tribulosa* Ferris, male and female.

Pleural plates (Fig. 109*D*) present on the second to seventh segments; plates of the second segment with the dorsal portion produced into a curved, tapering lobe and with the ventral portion bearing a small free lobe; between the two portions are two moderately large setæ; plates of the third segment consisting of a single tapering lobe bearing a single long and one very short seta; plates of the fourth, fifth, and sixth segments small, consisting of a single tapering lobe.

Abdomen with ten or more setæ on the second tergite, with sixteen to

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twenty-four on the third to seventh and ten on the eighth. Ventral side with the setæ arranged much as on the dorsum. Genital plate not chitinized, or at most weakly so. Margins of the ninth segment with two groups of small setæ.

MALE (Fig. 108). Length 1.1 mm. Closely resembling the female but with somewhat fewer setæ. *Genitalia* (Fig. 109*A*) with the posterior third of the basal plate (*bp*) strongly expanded, with the posterior angles strongly produced and with a slender median process posteriorly; parameres (*par*) slightly curved, not flattened; pseudopenis (*pp*) quite large, V-shaped.

NOTES.—From *F. pinnata* and *F. microcephala* this is readily separable by the form of the genitalia and the pleural plates.

Included among the material upon which this species was originally based and in the material now available there are two forms which differ in the character of the pleural plates. The status of these is somewhat doubtful, but for the present I am placing them as subspecies of *F. tribulosa*.

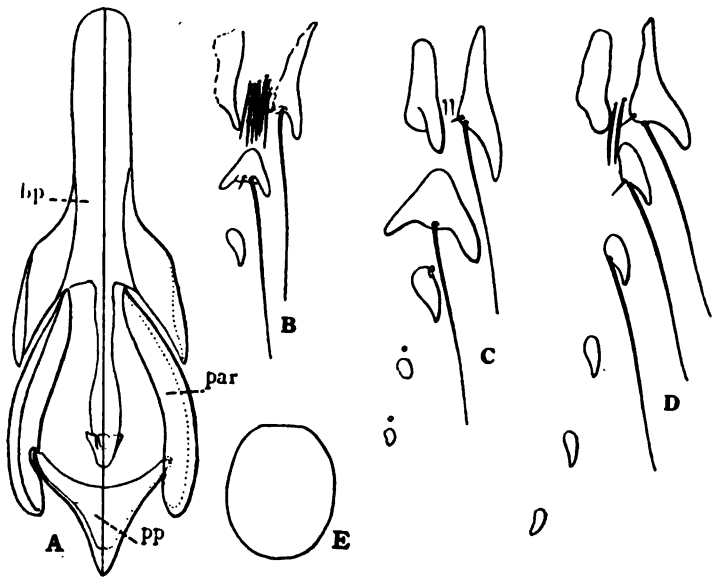

Fig. 109.—*Fahrenholzia tribulosa tribulosa* Ferris: *A*, genitalia of male; *D*, pleural plates; *E*, sternal plate. *F. tribulosa reducta* n. ssp.: *B*, pleural plates. *S. tribulosa zacatecæ* n. ssp.: *C*, pleural plates.

3b. Fahrenholzia tribulosa reducta n. ssp.

FIG. 109*B*.

1916. *Fahrenholzia tribulosa* Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 151 (part; without description).

1916. *Fahrenholzia tribulosa* Ferris, *Psyche* **23**: 102 (part).

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PREVIOUS RECORDS. Recorded as *Fahrenholzia tribulosa* Ferris from *Perognathus formosus,* Victorville, California.

SPECIMENS EXAMINED. As above recorded. Holotype a female.

MALE AND FEMALE. Differing from *F. tribulosa tribulosa* only in the character of the pleural plates (Fig. 109*B*) which are present on the second to fourth segments only. Plates of the second segment with the parts small and slender, tending to be weakly chitinized, the dorsal portion with one very long and one minute seta and with several stout setæ between the two portions; plates of the third segment bilobed but very small, bearing one long and one short seta; plates of the fourth segment consisting of a single small lobe.

3c. Fahrenholzia tribulosa zacatecæ n. ssp.

FIG. 109*C*.

SPECIMENS EXAMINED. From *Perognathus hispidus zacatecæ,* Valparaiso, Zacatecas, Mexico (U. S. N. M. 91875). Holotype a female.

MALE AND FEMALE. Differing from *F. tribulosa tribulosa* and *F. tribulosa reducta* only in the form of the pleural plates. Plates of the second segment as in *tribulosa;* plates of the third segment quite large, bilobed; plates of the fourth, fifth, and sixth segments quite small.

Genus **NEOLINOGNATHUS** Bedford.

1920. Bedford, *Ent. Monthly Mag.* (3) **6**: 88.

Anoplura without eyes; with five-segmented antennæ, which are not sexually dimorphic; legs with the tibia produced into a thumb-like process opposing the claw, the anterior pair weak, with slender claw, the middle and posterior pairs much larger, subequal, with the tarsus flattened and with stout claw; sternal plate divided longitudinally; pleural plates lacking; spiracles present only on the thorax and on the eighth abdominal segment; derm of the abdomen membranous, beset with minute points and with some large points which are chitinized, the whole giving the body a scaly appearance; head without post-antennal angles and with the occipital region but little constricted; genitalia of the males of a distinctive type, the parameres apparently lacking, the endomeres fused and much enlarged, the basal plate and pseudopenis very small.

HOSTS. Known only from members of the family *Macroscelidæ,* the "elephant shrews," of the order *Insectivora.*

TYPE OF THE GENUS. *Neolinognathus elephantuli* Bedford. This and *N. prælautus* n. sp. are the only included species.

1. Neolinognathus elephantuli Bedford.

FIGS. 110, 111*A–C*, 111*F*.

1920. *Neolinognathus elephantuli* Bedford, *Ent. Monthly Mag.* (3) **6**: 89–90; f.

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PREVIOUS RECORDS. From *Elephantulis rupestris jamesoni,* Anderstepoort, Transvaal, South Africa.

SPECIMENS EXAMINED. A male and several females from the type host and locality, received through the kindness of Mr. Bedford and numerous specimens from the following: *Petrodromus tetradactylus,* British Central Africa (U. S. N. M. 141526); *Nasilio brachyrhynchus delameri,* Loita Plains, British East Africa (U. S. N. M. 181461).

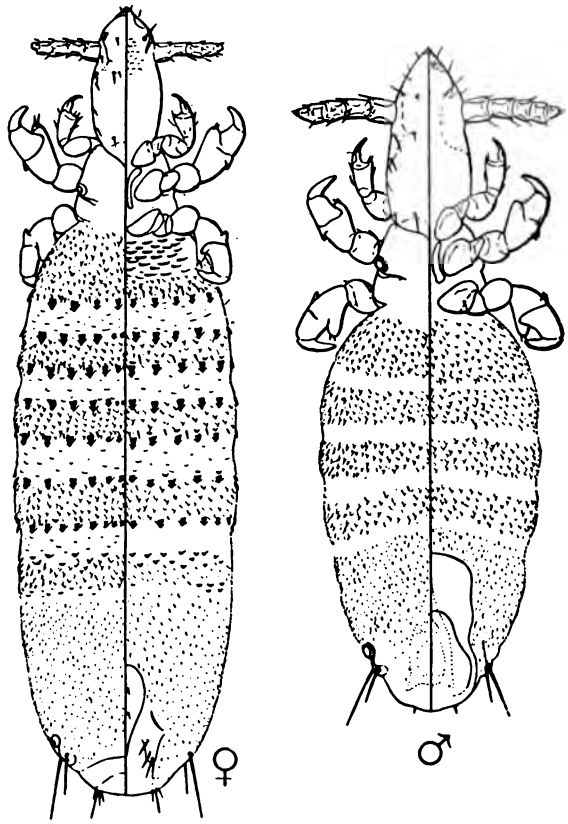

Fig. 110.—*Neolinognathus elephantuli* Bedford, male and female. Female from *Elephantulus rupestris jamesoni,* male from *Petrodromus tetradactylus.*

FEMALE (Fig. 110). Length 1–1.2 mm. *Head* slender, more than twice as long as wide, acute anteriorly. *Thorax* slightly wider than the head and scarcely as long, the lateral margins almost parallel; sternal plate (Fig. 111*B*) divided longitudinally into two irregular, slender plates; middle and anterior legs (Fig. 111*C*) with a distinct, tooth-like, preapical process on the outer margin of the tibia.

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Abdomen elongate and rather slender. Along the posterior margin of the second tergite and sternite and both the anterior and posterior margins of the third to fifth tergites and sternites is a definite, single row of enlarged, chitinized points (Fig. 111*F*). The remainder of the abdomen is beset with minute, unchitinized points. Ninth segment with the tergite chitinized; eighth with a pair of small setæ at each side. Sternal plate (Fig. 111*B*) chitinized, elongate oval, acute posteriorly; gonapods small; margins of ninth segment with a few small setæ.

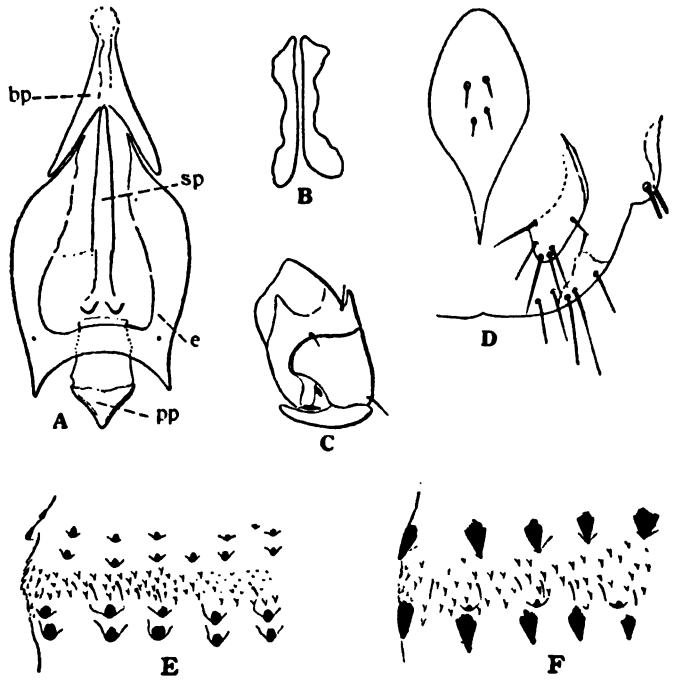

Fig. 111.—*Neolinognathus elephantuli* Bedford: *A*, genitalia of male; *B*, sternal plate; *C*, posterior tibia and tarsus; *F*, portion of abdomen. *Neolinognathus prælautus* n. sp.: *E*, portion of abdomen.

MALE (Fig. 110). Length 0.8 mm. In general resembling the female but with the abdomen entirely devoid of the larger, chitinized points. *Genitalia* (Fig. 111*A*) with the basal plate (*bp*) quite small, of an inverted Y-shape; parameres apparently lacking, replaced by a large ring sclerite which I regard as the fused endomeral pieces (*e*); pseudopenis (*pp*) very small.

NOTES.—The specimens from *Nasilio* differ from the others in the presence of large, chitinized points on the abdomen of the male. Otherwise they appear to be the same as typical examples.

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2. Neolinognathus prælautus n. sp.

FIGS. 111*E*, 112.

SPECIMENS EXAMINED. Holotype, a female, and allotype from *Elephantulus pulcher phæus,* Lime Springs, British East Africa (U. S. N. M. 181488). Also from *E. rufescens,* Vor, British East Africa (U. S. N. M. 182612).

FEMALE (Fig. 112). Length 1 mm. Differing from *N. elephantuli* chiefly in the absence of the tooth-like process on the tibiæ of the middle and posterior legs and in having the enlarged, chitinized points of the abdomen smaller, bluntly pointed and arranged in double instead of single rows.

MALE (Fig. 112). Differing from the male of *N. elephantuli* in lacking the tooth-like process on the middle and posterior tibiæ and in having a few of the larger, chitinized points along the posterior margins of the abdominal segments.

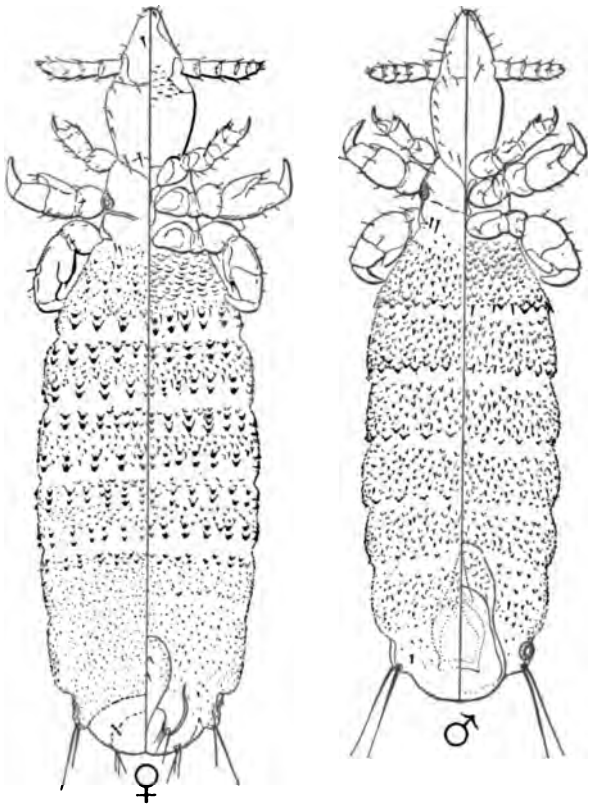

Fig. 112.—*Neolinognathus prælautus* n. sp., male and female.

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Genus **SCIPIO** Cummings.

1913. *Scipio* Cummings, *Bull. Ent. Res.* **3**: 393.
1916. *Neumanellus* Fahrenholz, *Archiv f. Naturgeschichte,* Abt. A., **81**, 11: 31.
1916. *Scipio* Ferris, *Annals Durban Museum* **1**: 232.
1916. *Scipio* Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 177.

Anoplura without eyes; with five-segmented antennæ which are not sexually dimorphic; legs with the tarsus produced into a thumb-like process opposing the claw, the first pair small, with weak claw and with a curved claw-like process rising beside the claw, second and third pairs much larger, subequal, with stout claw; pleural plates present on the third to eighth segments; abdomen entirely membranous except for small tergal plates in the male, each segment with not more than one row of setæ; ninth segment without a pair of flattened lobes on the ventral side.

Hosts. From rodents of the African genus *Thryonomys* of the family *Octodontidæ.*

Type of the Genus. *Hæmatopinus aulacodi* Neumann. But one other species, *Scipio breviceps* Ferris, is included.

Notes.—The most distinctive feature of this genus, a character which it shares only with the genus *Hybophthirus,* is that of the presence of the claw-like process on the anterior tarsi. This structure has at times been spoken of as a claw, but it is in all probability merely an enlarged spine, for it is not jointed at the base.

These two genera, *Scipio* and *Hybophthirus,* appear to be quite closely related, and it is only with some hesitation that I am regarding them as distinct. I shall discuss this point further in connection with the description of the latter genus.

1. **Scipio aulacodi** (Neumann).

Figs. 113, 114*A–B*, 114*E*, 114 *G.*

1911. *Hæmatopinus aulacodi* Neumann, *Archives de Parasitologie* **14**: 403–406; f. 5–7.
1913. *Scipio aulacodi* (Neum.), Cummings, *Bull. Ent. Res.* **3**: 393.
1916. *Scipio aulacodi* (Neum.), Ferris, *Annals Durban Museum* **3**: 233; tf. 16, 17B.
1916. *Neumannellus aulacodi* (Neum.), Fahrenholz, *Archiv f. Naturgeschichte,* Abt. A, **81**, 11: 31.
1919. *Scipio aulacodi* (Neum.), Bedford, *Rept. Div. Vet. Res., Dept. Agric. Un. S. Africa* **6-7**: 715.

Previous Records. Originally described from *Thryonomys* (= *Aulacodus*) *swinderianus,* Dahomey, Africa. Also recorded from the same host, Northeastern Rhodesia (Cummings); *Thryonomys* sp., Mfongosi, Zululand (Ferris); *Thryonomys aulacodus,* Rustenburg District, Transvaal (Bedford).

Specimens Examined. From *Thryonomys* sp., Mfongosi, Zululand.

Female (Fig. 113). Length 2.25 mm. *Head* (Fig. 114*G*) relatively very large, more than twice as long as wide, acute anteriorly and with the lateral margins of the hind head almost parallel. Antennæ long and slender.

Thorax somewhat shorter than the head, with the posterior angles chitinized and slightly lobed. *Pleural plates* quite small, each with the dorsal

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apical angle produced into a small tooth and each bearing a pair of slender setæ, those of the seventh and eighth pairs very long; spiracles small.

Abdomen with tergal and sternal plates undeveloped except for the ninth tergite and the genital plate on the eighth sternite. Dorsal setæ

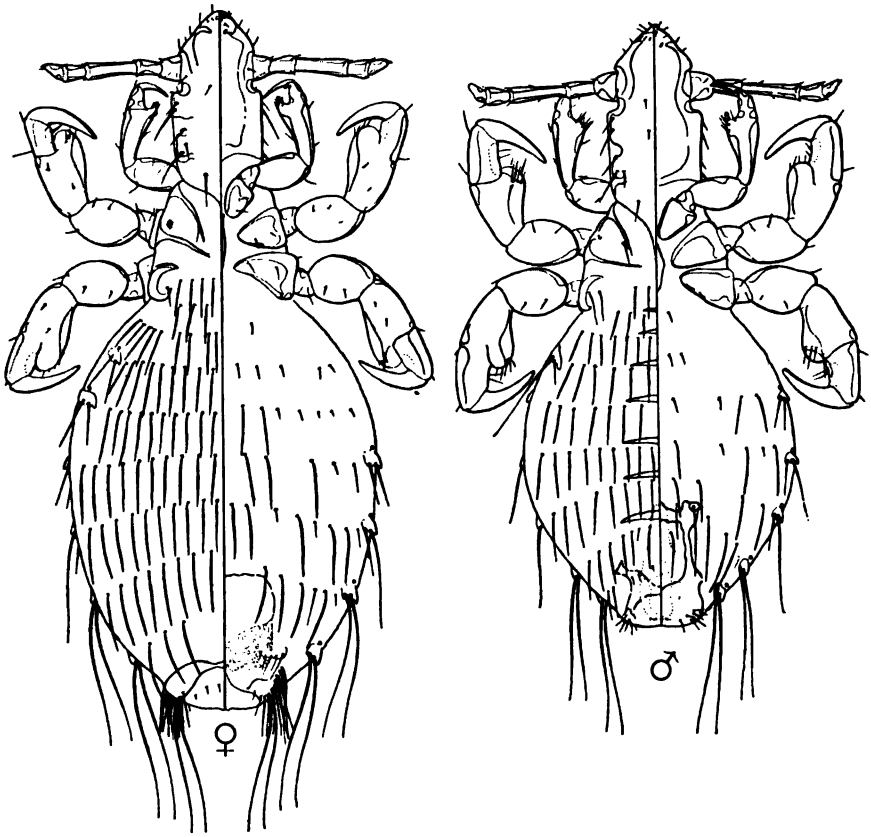

Fig. 113.—*Scipio aulacodi* (Neum.), male and female. From specimens from *Thryonomys* sp., Mfongosi, Zululand.

slender, the posterior margin of the thorax with six or eight, the first tergite with six, the second to seventh tergites with sixteen to twenty, the eighth with six. On the ventral side the setæ on the first four segments tend to be very small and few, and on the remaining segments small setæ are mingled with the larger. *Gonapods* (Fig. 114*E*) with several slender setæ and the lateral margins of the ninth segment with a fringe of long setæ. The wall of the vagina is chitinized and presents a tessellated appearance, the tessellations (Fig. 114*B*) more or less regularly polygonal, the interspaces narrow.

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MALE (Fig. 113). Length 1.9 mm. In general form resembling the female but with small tergal plates on the abdominal segments. Dorsum of the abdomen with for the most part fourteen to twenty setæ in a row; venter with the setæ few, in part very small.

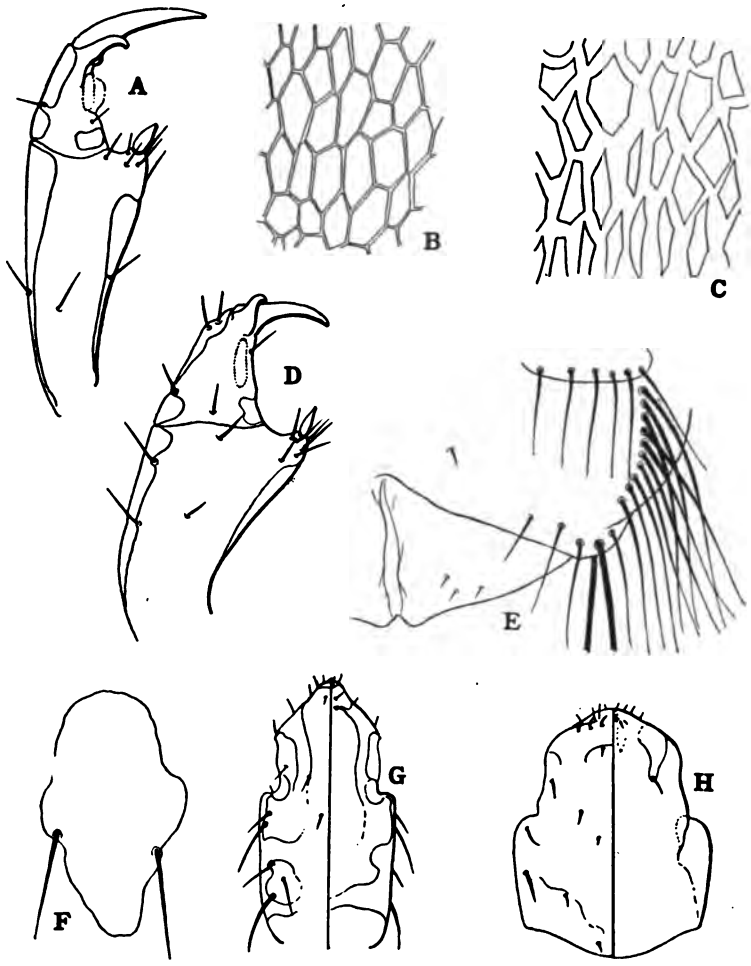

Fig. 114.—*Scipio aulacodi* (Neum.): *A*, anterior tibia and tarsus; *B*, tessellations on wall of vagina; *G*, head. *S. breviceps* Ferris: *C*, tessellations on wall of vagina; *D*, anterior tibia and tarsus; *E*, genital region of female; *F*, sternal plate; *H*, head.

Genitalia (Fig. 116*B*) with the basal plate (*bp*) broad, expanded posteriorly; parameres (*par*) rather short and stout, tapering to the apex, which is somewhat hooked and enclosing a ring-shaped, flattened piece which is perhaps the fused endomeres (*e*); pseudopenis (*pp*) very small.

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NOTES.—From the only other species of this genus, *S. breviceps* Ferris, this differs most conspicuously in the form of the head, and in the much smaller pleural plates.

These two species occur together upon the same host species. They represent one of the few cases of the occurrence of species of the same genus upon the same host.

2. Scipio breviceps Ferris.

FIGS. 114*C–D*, 114*F*, 114*H*, 115, 116.

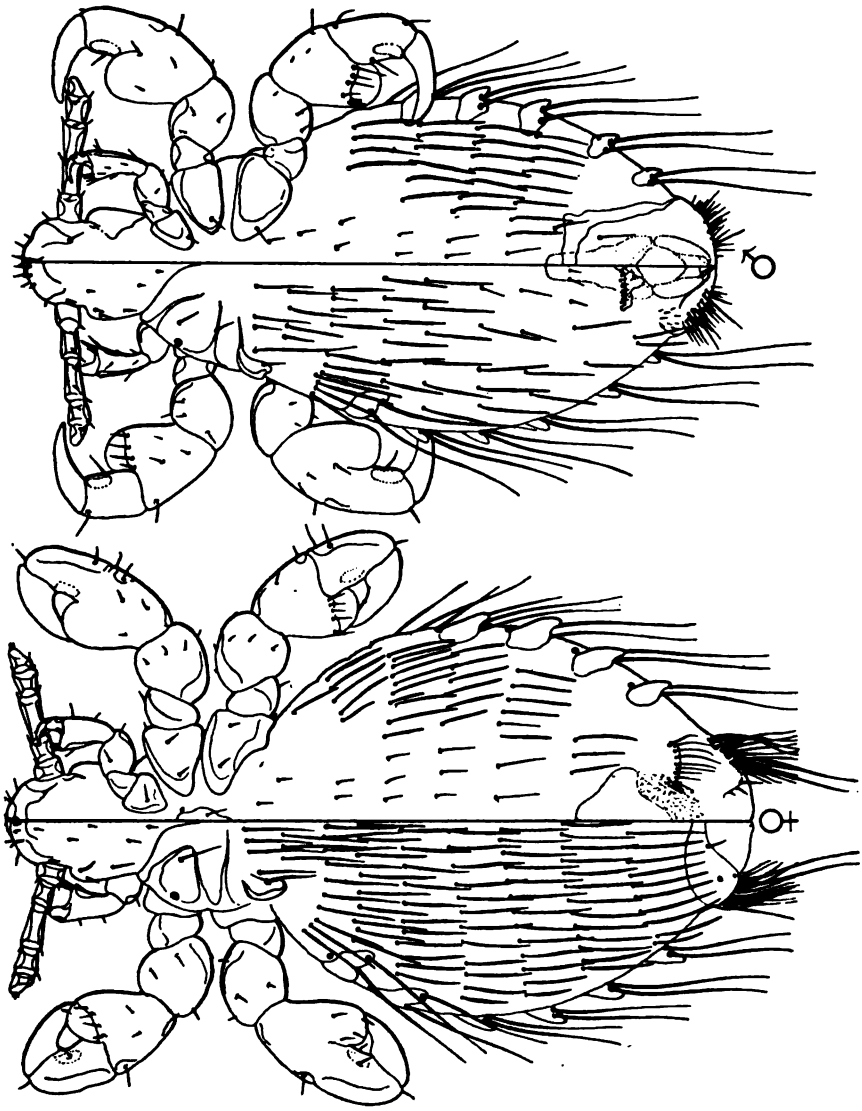

Fig. 115.—*Scipio breviceps* Ferris, male and female.

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1916. *Scipio breviceps* Ferris, *Annals Durban Museum* 3: 234; tf. 17A, 18–22.
1916. *Scipio breviceps* Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 178.
1919. *Scipio breviceps* Ferris, Bedford, *Rept. Div. Vet. Res., Dept. Agric. Un. S. Africa* 6-7: 715.

PREVIOUS RECORDS. Originally described from *Thryonomys* sp., Mfongosi, Zululand. Also recorded by Bedford from *Thryonomys aulacodus*, Rustenburg District, Transvaal.

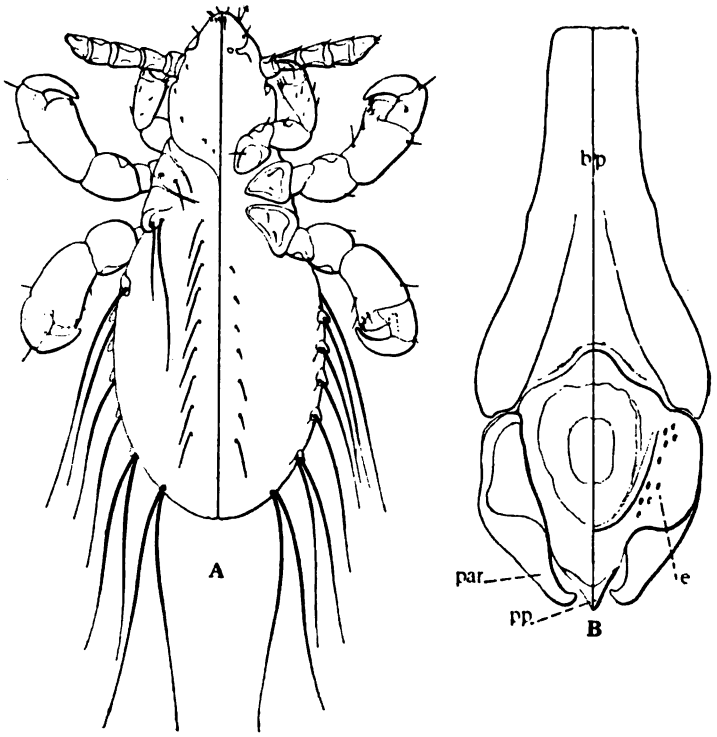

Fig. 116.—*Scipio breviceps* Ferris: *A*, first (?) stage; *B*, genitalia of male.

SPECIMENS EXAMINED. The types.

FEMALE (Fig. 115). Length 1.9 mm. *Head* (Fig. 114*H*) but little longer than broad. *Thorax* about as long as the head; sternal plate (Fig. 114*F*) irregular in form, bearing a pair of small setæ. Pleural plates of the same type as in *S. aulacodi* but larger, each with a pair of slender setæ; spiracles small.

Abdomen as in *S. aulacodi*, the tergites with for the most part sixteen to twenty-five quite long setæ; sternites with the setæ in the median region tending to be very small, those near the margins large. Ventral side of

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the ninth segment as in *S. aulacodi.* Wall of the vagina tessellated, the tessellations irregular and with large interspaces (Fig. 114*C*).

MALE (Fig. 115). Length 1.7 mm. In general resembling the female but with fewer setæ. Tergal plates not developed. Genitalia as in *S. aulacodi.*

IMMATURE STAGES. Representatives of a single immature stage (Fig. 116*A*) are available, this probably being the first. In this stage the claw-like process of the anterior tarsi is lacking. The pleural plates are much as in the adult but very small. The abdomen bears merely a median pair of setæ on each segment, dorsally and ventrally.

Genus **HYBOPHTHIRUS** Enderlein.

1909. Enderlein, *Denks. d. Med.-Naturw. Gesell. zu Jena* **14**: 79.
1913. Cummings, *Bull. Ent. Res.* **4**: 44.

Anoplura without eyes; with five-segmented antennæ, which are not sexually dimorphic; legs with the tibia produced into a thumb-like process opposing the claw, the anterior pair small and weak, with a curved, claw-like process rising beside the slender claw, anterior and middle pairs large and stout, subequal, with stout claw; thorax with the apical angles produced into distinct lobes; abdomen with not more than one row of setæ on each segment, dorsally and ventrally, in both sexes; pleural plates present on the second to eighth segments; ventral side of the ninth segment with a pair of lobe-like processes; head with distinct post-antennal angles.

HOSTS. Known only from the "Aard-Vark" or "Cape ant bear," of the genus *Orycteropus,* the only genus of the order *Tubulidentata.*

TYPE OF THE GENUS. *Hæmatopinus notophallus* Neumann.

NOTES.—As I have pointed out under the discussion of the genus *Scipio,* I regard these two genera as very closely related. They differ most conspicuously in the matter of size, *H. notophallus* being one of the largest of the Anoplura and reaching a length of 4.5 mm., while neither of the species of *Scipio* attains a length of over 2.5 mm. This is hardly to be regarded as a generic difference, however. Structurally the two genera differ chiefly in the presence of but six pairs of pleural plates in the two species of *Scipio,* in which the plates are lacking on the second segment, while there are seven pairs in *Hybophthirus.* The strongly produced apical lobes of the thorax in *Hybophthirus* are to some extent distinctive, although there is a tendency toward this condition in *Scipio.* The pair of lobe-like processes on the ventral side of the ninth abdominal segment in *Hybophthirus* is perhaps of generic value.

In the original description of this genus Enderlein laid special emphasis upon the presence of the thoracic lobes and the two-segmented condition of the anterior tarsi, while he overlooked the presence on the anterior legs of the claw-like process. The matter of the two-segmented tarsus is not significant, for this condition is evident in a wide range of genera. Nor is the presence of the thoracic lobes significant, for the same condition appears in the genus *Hæmatopinus.*

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1. Hybophthirus notophallus (Neumann).

FIGS. 117, 118.

1909. *Hæmatopinus notophallus* Neumann, *Jahrb. des Nassausischen Ver. für Naturkunde in Wiesbaden*, p. 2.

1909. *Hybophthirus orycteropodi* Enderlein, *Denks. des Med.-Naturw. Gesell. zu Jena* 14: 79–80; pl. 8, f. 1–3.

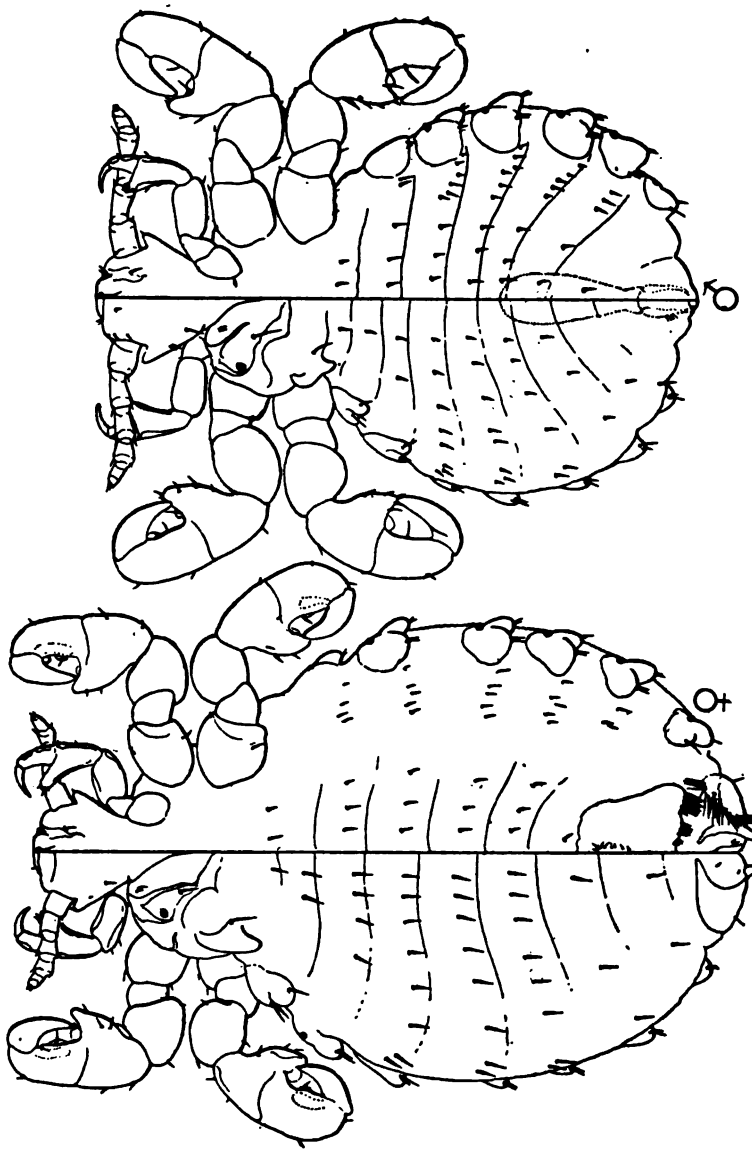

Fig. 117.—*Hybophthirus notophallus* (Neum.), male and female.

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1913. *Hybophthirus notophallus* (Neumann), Cummings, *Bull. Ent. Res.* **4**: 44.
1914. *Hybophthirus notophallus* (Neum.), Waterston, *Annals South African Museum* **10**: 278.
1916. *Hybophthirus notophallus* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 157.
1916. *Hybophthirus notophallus* (Neum.), Cummings, *Proc. Zool. Soc. London*, pp. 267–9; tf. 7–8.
1919. *Hybophthirus notophallus* (Neum.), Bedford, *Rept. Div. Vet. Res., Dept. Agric. Un. S. Africa* **6-7**: 715.

PREVIOUS RECORDS. Originally described from *Orycteropus afer*, "Gochas, Afrique occidentale allemande." Also recorded from the same species, "Klein-Namaland; Umgebung von Steinkopf" (Enderlein); and in the Zoological Garden at London (Cummings, 1916); from *O. capensis*, without locality (Waterston), and in the Zoological Garden at Pretoria, South Africa (Bedford).

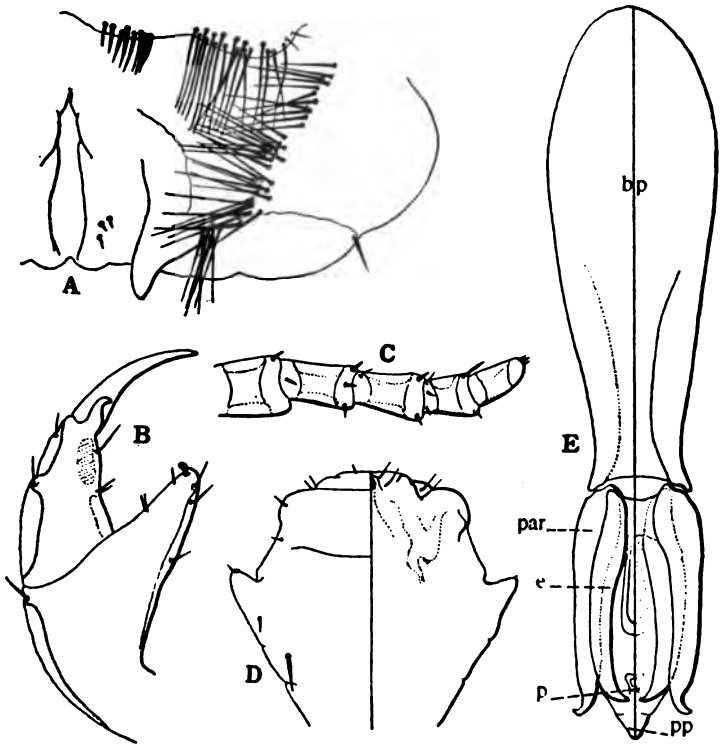

Fig. 118.—*Hybophthirus notophallus* (Neum.): *A*, genital region of female; *B*, anterior tibia and tarsus; *C*, antenna; *D*, head; *E*, genitalia of male.

SPECIMENS EXAMINED. Several examples from *Orycteropus capensis*, Zoological Garden, Pretoria, South Africa, received through the kindness of Mr. Bedford.

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FEMALE (Fig. 117). Length 4.5 mm. General form very stout. *Head* (Fig. 118*D*) relatively small, almost truncate in front, but little longer than wide, with the post-antennal angles very acute and with the lateral margins of the hind head almost straight and sharply convergent.

Thorax slightly longer than the head and more than twice as wide, with the lateral margins strongly arcuate, the posterior lateral angles bearing a strong, chitinized, lobe-like process; sternal plate not chitinized. Claw-like process of the anterior legs (Fig. 118*B*) small but distinct.

Abdomen almost circular. *Pleural plates* quite large, but not overlapping, all of much the same form, each with a rounded, projecting dorsal lobe and each bearing a pair of small setæ. Spiracles small. Seventh and eighth segments without long setæ at the lateral margins. Dorsal and ventral setæ few and small. Ninth segment beneath (Fig. 118*A*) with two clusters of numerous setæ and with a pair of flat, lobe-like processes; posterior margin of the genital plate with numerous small setæ.

MALE (Fig. 117). Length 3.5 mm. In general appearance closely resembling the female. *Genitalia* (Fig. 118*E*) with the basal plate (*bp*) quite long, not expanded posteriorly; parameres (*par*) long and nearly straight, enclosing the two endomeral pieces (*e*) and the penis (*p*); pseudopenis (*pp*) very small.

IMMATURE STAGES. Cummings (1916) has described the first stage. This differs from the adult in the entire absence of pleural plates, and in lacking the post-antennal angles.

NOTES.—Cummings (1913) has pointed out that Neumann's description of this species has priority over that of Enderlein.

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BIOLOGICAL SCIENCES

VOLUME II NUMBER 4

Contributions Toward a Monograph of the Sucking Lice

PART IV.

BY

GORDON FLOYD FERRIS

Assistant Professor of Entomology

STANFORD UNIVERSITY, CALIFORNIA
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SYSTEMATIC TREATMENT (Cont.)

Genus **POLYPLAX** Enderlein.

1904. *Polyplax* Enderlein, *Zool. Ans.* **28**: 139, 142, 223.
1907. *Eremophthirius* Glinkiewicz, *Sitz. d. Kaiserl. Ak. Wiss. Wien, Natur. Klasse* **116**: 381–83.
1908. *Polyplax* Dalla Torre, "Anoplura," *Gen. Ins.*, p. 13.
1909. *Hæmatopinus* (*Polyplax*) Neumann, *Arch. de Parasit.* **13**: 529–32.
1910. *Polyplax* Mjöberg, *Arkiv f. Zool.* **6**: 159.
1912. *Polyplax* Fahrenholz, *Jahresb. des Niedersäch. Zool. Ver.* **2–4**: 29–30.
1913. *Polyplax* Patton and Cragg, "Textbook of Medical Entomology," p. 543.
1915. *Polyplax* Kellogg and Ferris, "Anoplura and Mall. North Amer. Mamm.," *Stanford Univ. Publ.*, p. 11.
1916. *Polyplax* Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 171.

Anoplura without eyes; with five-segmented antennæ which are frequently sexually dimorphic, the third segment in the male having the distal, pre-axial angle more or less produced and terminating in a recurved spine or stout seta; with the anterior legs small and weak, the middle legs usually somewhat stouter than the anterior but of the same shape, the posterior legs stouter and with broader claw than the middle; pleural plates always developed, present on the second to seventh or eighth segments, those of the second segment usually distinctly divided longitudinally; female with two rows of setæ on the second and fourth to seventh abdominal tergites and the second to seventh sternites, these usually, but not always, accompanied by more or less well developed plates; male typically with two rows of setæ on the second tergite and second and third sternites of the abdomen but sometimes with only a single row on all the sternites or exceptionally two rows on the second to eighth sternites, always with but a single row on the other tergites and sternites; second plate of the second tergite in the male not emarginate posteriorly; sternal plates of the second and third abdominal segments never extending from pleurite to pleurite; head usually with distinct post-antennal angles and with a distinctly constricted occipital region; genitalia of the males of no especially distinctive type but always with the basal plate undivided and with the pseudo-penis usually wedge-shaped.

Hosts. Occurring as far as known only on rodents of the family *Muridæ* (the rats and mice) with the exception of two species that occur on members of the insectivoran genus *Sorex*.

Type of the Genus. *Pediculus spinulosus* Burmeister.

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SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS:

NOTE.—Names in italics are synonyms of the name with which they are coupled.

acanthopus (Burmeister).
Hoplopleura acanthopus (Burmeister).
aculeatus Neumann.
Eulinognathus aculeatus (Neumann).
affinis (Burmeister) (misidentification).
Polyplax serrata (Burmeister).
affinis (Burmeister).
Hoplopleura affinis (Burmeister).
antennata (Osborn).
Neohæmatopinus sciurinus (Mjöberg).
arvicanthis Bedford (amended spelling).
Polyplax arvicanthus Bedford (typographical error).
Polyplax arvicathus Bedford (typographical error).
arvicanthus Bedford (typographical error).
Polyplax arvicanthis Bedford.
arvicathus Bedford (typographical error).
Polyplax arvicanthis Bedford.
auricularis Kellogg and Ferris.
bidentata (Neumann).
Hoplopleura bidentata (Neumann).
brachyrrhynchus Cummings.
calva Waterston.
clavicornis (Nitzsch).
Pediculus clavicornis Nitzsch (of uncertain position).
columbianus (Osborn).
Neohæmatopinus læviusculus (Grube).
cummingsi Ferris.
Polyplax gracilis Fahrenholz (misidentification).
echinata Neumann.
Neohæmatopinus echinatus (Neumann).
erratica (Osborn).
Hoplopleura erratica (Osborn).
gracilis Fahrenholz.
gracilis Fahrenholz (misidentification).
Polyplax cummingsi Ferris.
hesperomydis (Osborn).
Hoplopleura hesperomydis (Osborn).
jonesi Kellogg and Ferris.
læviuscula (Grube).
Neohæmatopinus læviusculus (Grube).
longula (Neumann).
Hoplopleura longula (Neumann).
maniculata Neumann.
Hoplopleura maniculata (Neumann).
miacantha Speiser.
montana (Osborn).
Neohæmatopinus læviusculus (Grube).

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Hoplopleura quadridentata (Neumann).
otomydis Cummings.
oxyrrhynchus Cummings.
pectinata Cummings.
Hoplopleura pectinata (Cummings).
pectinifer Neumann.
Neohæmatopinus pectinifer (Neumann).
pleurophæa (Burmeister).
Schizophthirus pleurophæus (Burmeister).
præcisa (Neumann) (part).
Hæmatopinus præcitus Neumann (part; typographical error).
Hæmatopinus (Polyplax) præcisus (Neumann) (part).
præcisa (Neumann) (part).
Hoplopleura neumanni Fahrenholz.
præcita (Neumann) (typographical error).
Polyplax præcisa Neumann (part).
Hoplopleura neumanni Fahrenholz (part).
quadridentata Neumann.
reclinata (Nitzsch).
Pediculus reclinatus Nitzsch.
Hæmatopinus reclinatus (Nitzsch).
Hæmatopinus (Polyplax) spiniger reclinatus (Nitzsch).
sciuropteri (Osborn).
Neohæmatopinus sciuropteri (Osborn).
serrata (Burmeister).
Pediculus serratus Burmeister.
Hæmatopinus serratus (Burmeister).
Polyplax affinis (Burmeister) (misidentification).
sphærocephala (Burmeister).
Enderleinellus sphærocephalus (Burmeister).
spiculifera (Gervais).
Pediculus spiculiferus Gervais (of uncertain position).
spiniger (Burmeister).
Pediculus spiniger Burmeister.
Hæmatopinus spiniger (Burmeister).
spiniger reclinata (Burmeister).
Polyplax reclinata (Burmeister).
spinulosa (Burmeister).
Pediculus spinulosus Burmeister.
Hæmatopinus spinulosus (Burmeister).
Pediculus denticulatus Nitzsch.
stephensi (Christophers and Newstead).
Hæmatopinus stephensi Christophers and Newstead.
Hæmatopinus (Polyplax) stephensi Christophers and Newstead.
suturalis (Osborn).
Enderleinellus suturalis (Osborn).
ventricosa (Denny).
Hæmodipsus ventricosus (Denny).
villosa Galli-Valerio.

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Hoplopleura acanthopus (Burmeister).
waterstoni Bedford.
werneri (Glinkiewicz).
Eremophthirius werneri Glinkiewicz.

NOTES.—This genus, as I have here defined it, forms a very homogeneous group with the exception of one species, *P. calva,* the inclusion of which somewhat complicates the diagnosis. The only difficulty is to exclude from it certain other groups, such as *Neohæmatopinus* and *Eulinognathus,* which in their typical form are distinct enough but which grade sufficiently toward *Polyplax* to make their separation difficult even though it appears justifiable.

The most distinctive character of *Polyplax*—as compared with these closely related genera—is that of the form of the pleural plates of the second abdominal segment. In the majority of the species these plates are very distinctly divided longitudinally into two pieces. The arrangement is very similar to that seen in the genus *Fahrenholzia* except that there is no tendency for the ventral piece to migrate to the ventral side of the body. In one or two species these plates are apparently not divided and in all well-stained preparations are necessary in order to determine the point with certainty.

Aside from this the arrangement of the setæ on the abdomen of the male is quite characteristic. Typically there are but two rows of setæ on the second tergite and the second and third sternites with a single row on the remaining segments. In some cases, however, there is but a single row on all the sternites and in the case of the rather anomalous species, *P. calva,* there are two rows on the third to seventh sternites. The second row of the second tergite in the male is never arranged along an emarginate plate as in *Neohæmatopinus.*

Typically the antennæ are sexually dimorphic (Fig. 120*D*), the third segment in the male being modified, but some species show no trace of this although in other respects they appear to be representative of the genus.

My material of the immature stages is very scanty and for a description of these I am relying chiefly upon the notes given by Cummings[1] with which my observations are in accord as far as they go. According to Cummings there are at least three immature stages, during all of which the head, thorax and legs are essentially as in the adult, the chief differences being in the abdomen. In the first stage the pleural plates are entirely lacking and the setæ are reduced to a median series, dorsally, of two on each segment. In the second stage the rudiments of the pleural plates appear and a median series of two setæ appears on each sternite. In the third stage the pleural plates are still more strongly developed. According to my own observations there is in this stage no trace of the division of the pleurites of the second segment.

There are listed in this paper 26 species of *Polyplax,* of which eight are described as new. Of three of the described species I have not seen material. Two species of the older authors which have previously been referred to *Polyplax* are here excluded as unrecognizable and will be listed in a section reserved for such species at the end of this series of papers. These two species are *Pediculus clavicornis* Nitzsch and *P. spiculiferus* Gervais.

[1] Cummings, B. F. *Proceedings Zool. Soc. London,* pp. 260–71. 1915.

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1. Polyplax spinulosa (Burmeister).

FIGS. 119, 120*A*, 120*D*, 120*F*, 120*H*.

1839. *Pediculus spinulosus* Burmeister, "Rhynchota," *Gen. Ins.* No. 8.
1842. *Hæmatopinus spinulosus* (Burm.), Denny, "Mon. Anopl. Brit.," p. 26; pl. 24, f. 5.
1842. *Hæmatopinus spiniger* (Burm.), Denny, *ibid.*, p. 27; pl. 24, f. 6.
1864. *Pediculus denticulatus* Nitzsch, *Zeits. f. ges. Naturw.* 23: 24.
1874. *Hæmatopinus spinulosus* (Burm.), Giebel, "Insecta Epizoa," pp. 38–9; pl. 1, f. 7.
1880. *Hæmatopinus spinulosus* (Burm.), Piaget, "Les Pediculines," pp. 636–7; pl. 52, f. 2.
1891. *Hæmatopinus spinulosus.* (Burm.), Osborn *U. S. Dept. Agric., Div. Ent., Bul.* 7, o. s.: 22.
1896. *Hæmatopinus spinulosus* (Burm.), Osborn, *ibid., Bul.* 5, n. s.: 181.
1904. *Polyplax spinulosa* (Burm.), Enderlein, *Zool. Anz.* 28: 142.
1904. *Hæmatopinus spinulosus* (Burm.), Tiraboschi, *Arch. de Parasit.* 8: 316–7; fig.
1905. *Polyplax spinulosa* (Burm.), Enderlein, *Zool. Anz.* 29: 192–4.
1908. *Polyplax spinulosa* (Burm.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.
1909. *Hæmatopinus* (*Polyplax*) *spinulosus* (Burm.), Neumann, *Arch. de Parasit.* 13: 526; fig. 26.
1910. *Polyplax spinulosa* (Burm.), Mjöberg, *Ark. f. Zool,* 6: 160.
1910. *Polyplax spinulosa* (Burm.), Banks, *U. S. Treasury Dept. Bul.* 30: 79; f. 7.
1912. *Polyplax spinulosa* (Burm.), Mjöberg, *Tijdschr. Ent.* 55: 336–7.
1912. *Polyplax spinulosa* (Burm.), Fahrenholz, *Jahresb. des Niedersäch. Zool. Ver.*, 2–4: 30–7; tf. 8–10; pl. 2, f. 8–13.
1913. *Polyplax spinulosa* (Burm)., Johnston and Harrison, *Proc. Royal Soc. Queensland* 24: 107.
1913. *Hæmatopinus* (*Polyplax*) *spinulosus* (Burm.), Patton and Cragg, "Textbook of Medical Entomology," p. 550.
1913. *Polyplax spinulosa* (Burm.), Evans, *Proc. Royal Physical Soc. Edinburgh* 19: 93.
1915. *Polyplax spinulosa* (Burm.), Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.*, pp. 12–3; tf. 1; pl. 5, f. 11a–b; pl. 6, f. 7.
1915. *Polyplax spinulosa* (Burm.), Cummings, *Proc. Zool. Soc. London*, pp. 256–7, 268–71; tf. 7, 15, 16.
1916. *Polyplax spinulosa* (Burm.), Ferris, *Psyche* 23: 99.
1917. *Polyplax spinulosus* (Burm.), Moll, *Jn. Parasitology* 4: 89–90.
1919. *Polyplax spinulosa* (Burm.), Bedford, *Rept. Div. Vet. Res., Dept. Agric. Un. S. Africa,* 6–7: 715.

PREVIOUS RECORDS. Originally described from the "brown rat," *Epimys norvegicus* (= *Mus decumanus*) in Europe. It has been recorded from this species and from *E. rattus* and *E. rattus alexandrinus* in many parts of the world and from *Microtus californicus, Microtus* sp. and *Phenacomys longicaudus* in California and *Microtus intermedius,* Nevada, U. S. A. (Kellogg and Ferris; Ferris). Neumann has recorded it from *Apodemus* (= *Mus*) *sylvaticus* but it is probable that he was dealing with *P. serrata.*

SPECIMENS EXAMINED. From *Epimys norvegicus,* England (Water-

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ston; Nuttall); California; Melbourne, Australia (H. F. Clinton); *Epimys rattus,* Amritsar District and Punjab, India (Indian Museum); Galapagos Islands, Panama Canal Zone (L. H. Dunn); *Epimys rattus kijabius* and undetermined host, Kakamega, Kenya Colony, British East Africa (British Museum); *Epimys calcis,* Baguio, Luzon, Philippine

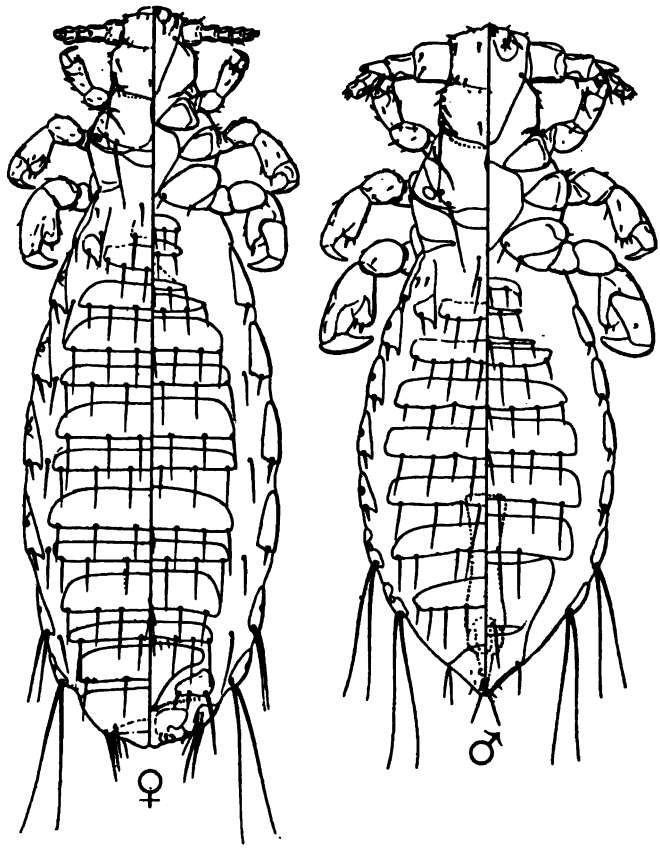

Fig. 119.—*Polyplax spinulosa* (Burm.): female from *Epimys rattus,* Panama Canal Zone, male from the same host, Galapagos Islands.

Islands (U. S. N. M. 145778); *Epimys stridens,* Pulo Troman, Malay Peninsula (U. S. N. M. 104998); *Gunomys bengalensis,* Burma (Nuttall); "*Mus* sp.," Java (E. Jacobson) and Anderstepoort, South Africa (Bedford); *Microtus californicus* and *Microtus* sp. and *Phenacomys longicaudus,* California; *Synaptomys borealis,* Norway House, Northwest Territory, Canada; *Apodemus sylvaticus,* England (Waterston); *Crocidura*

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cærulea, Rangoon, Burma (Nuttall); "rat," British Guiana (British Museum).

Of these hosts the next to the last named is an insectivore of the family *Soricidæ* (the shrews), the others are rodents, all belonging to the family *Muridæ,* the genera *Microtus, Phenacomys* and *Synaptomys* being members of the subfamily *Microtinæ,* the others of the subfamily *Murinæ.*

FEMALE (Fig. 119). Length 1.3 mm. General form moderately stout. *Head* nearly as broad as long, almost truncate anteriorly, with the antennæ set close to the anterior margin, with prominent post-antennal angles and a constricted occipital region and with the lateral margins of the hind head parallel. *Thorax* somewhat longer and broader than the head, with the lateral margins angularly convex; legs of ordinary form, the middle pair intermediate in stoutness between the anterior and posterior pairs; sternal plate (Fig. 120*A*) broad, with the lateral margins almost parallel, the posterior margin produced into a blunt point.

Pleural plates (Fig. 120*H*) as follows: plates of the second segment distinctly divided into two lobes, the ventral lobe slender, the dorsal broader and produced into a slight tooth, each lobe with a short seta; plates of the third to sixth segments triangular, with the dorsal posterior angle produced into a slight tooth and the ventral angle somewhat rounded, each plate with a pair of short, thorn-like setæ of nearly equal length on the posterior margin; plates of the seventh and eighth segments smaller, each with a pair of long setæ; spiracles quite small.

Tergal and sternal plates of the abdomen strongly developed, reaching nearly from pleurite to pleurite and occupying the greater part of the surface, the anterior plate of each segment tending to be considerably longer than the posterior, the plates with for the most part five to seven small, slender and quite widely spaced setæ. Between the ends of the posterior plate and the corresponding pleurite on the third to seventh segments dorsally and the fourth to seventh segments ventrally is a single small seta.

MALE (Fig. 119). Length .9 mm. *Head* relatively broader and stouter than in the female, the first segment of the antennæ (Fig. 120*D*) more swollen, the third segment strongly modified.

Tergal and sternal plates and rows of setæ of the abdomen arranged in the typical manner, the plates strongly developed, occupying the greater part of the width of the abdomen and with for the most part seven or eight small, slender setæ of varying lengths.

Genitalia (Fig. 120*F*) with the basal plate (*bp*) moderately stout, the posterior angles strongly produced and enclosing the anterior end of the parameres (*par*), the latter short, strongly curved and articulating closely at their apices with the stout, wedge-shaped pseudopenis (*pp*). The

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pseudopenis is strongly curved dorso-ventrally in the form of a hook and has slight lateral expansions at the proximal end. Between the parameres is the penis (*p*) with somewhat vague and weakly chitinized structures which probably represent the endomeral pieces.

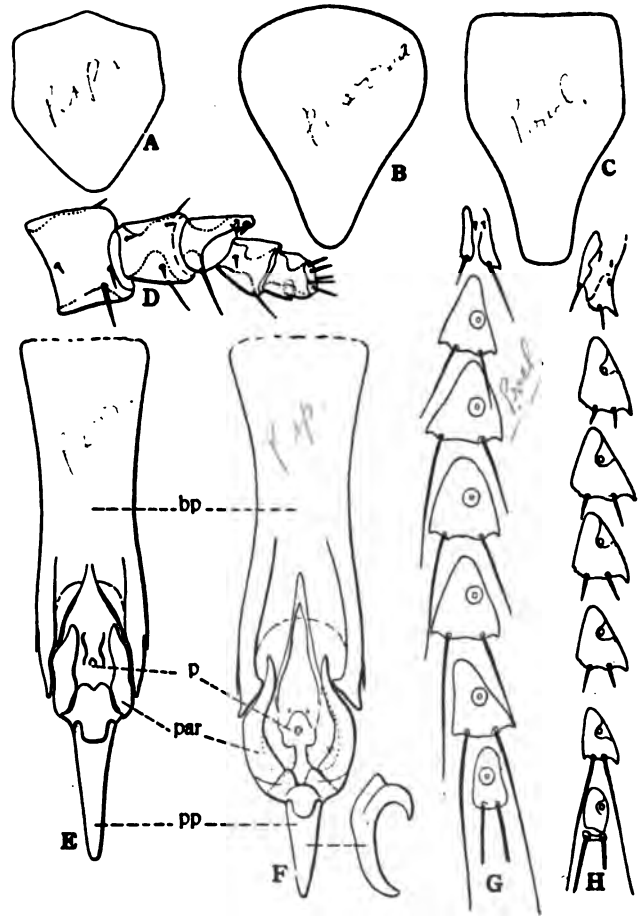

Fig. 120.—*Polyplax spinulosa* (Burm.): *A*, sternal plate; *D*, antenna of male; *F*, genitalia of male; *H*, pleural plates of female, from same specimens as in Fig. 119. *Polyplax serrata* (Burm.): *B*, sternal plate; *E*, genitalia of male; from specimens from *Apodemus sylvaticus sylvaticus*, Europe. *Polyplax reclinata* (Nitzsch): *C*, sternal plate; *G*, pleural plates of female; from *Crocidura* sp., Valley of Kashmir.

NOTES.—This species appears characteristically to be associated with the "domestic rats" but it is evidently normal also to at least a part of the hosts recorded above and

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it evidently transfers with some readiness from one host species to another. I am quite unable to detect any differences between the specimens from these different hosts. *P. spinulosa* is very similar to *P. serrata* and *P. reclinata* but these three species differ so constantly in certain details that I do not question their distinctness, even though *spinulosa* may occur upon the same hosts as the others at times. The differences will be pointed out in connection with the discussions of *serrata* and *reclinata*.

Through the very great kindness of Mr. James Waterston of the British Museum I have been enabled to examine one of the original specimens recorded by Denny from *Arvicola* (=*Hypudæus*) *amphibius* as *Hæmatopinus spiniger* (Burm.). This specimen seems to me to be undoubtedly identical with *spinulosus*.

2. Polyplax serrata (Burmeister).

FIGS. 120*B*, 120*E*.

1839. *Pediculus serratus* Burmeister, "Rhynchota," *Gen. Ins.* No. 6.
1842. *Hæmatopinus serratus* (Burm.), Denny, "Mon. Anopl. Brit." p. 36.
1864. *Pediculus serratus* Burm., Nitzsch, *Zeit. f. ges. Naturw.* 23: 27.
1874. *Hæmatopinus serratus* (Burm.), Giebel, "Insecta Epizoa," p. 36; pl. 1, f. 6.
1880. *Hæmatopinus serratus* (Burm.), Piaget, "Les Pediculines," p. 639.
1904. *Polyplax serrata* (Burm.), Enderlein, *Zool. Anz.* 28: 142.
1904. *Polyplax serratus* (Burm.), Csiki, *Rovart. Lapok* 11: 182.
1908. *Polyplax serrata* (Burm.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.
1912. *Polyplax affinis* (Burm.), Fahrenholz, *Jahresb. des Niedersäch. Zool. Ver.* 2–4: 39–42; tf. 13–15. (Misidentification).
1913. *Polyplax serrata* (Burm.), Evans, *Proc. Royal Phys. Soc. Edinburgh* 19: 94.
1916. *Polyplax affinis* (Burm.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 172 (part).
1916. *Polyplax serrata* (Burm.), Ferris, *ibid.* p. 175.

PREVIOUS RECORDS. Originally described from the "house mouse," *Mus musculus*, in Europe. It has since been recorded from this host only from the Forth District, Scotland and the Shetland Islands (Evans). Under the name of *Polyplax affinis* (Burm.) it has been recorded by Fahrenholz from *Apodemus* (=*Mus*) *sylvaticus*, Europe.

SPECIMENS EXAMINED. From *Mus musculus*, Edinburgh, Scotland (Waterston), and "tame mouse," England (Waterston); *Mus spicilegus hispanicus*, Valencia, Spain (U. S. N. M. 152840); *Apodemus agrarius mantchuricus*, Sungaree River, Manchuria (U. S. N. M. 197805); *A. agrarius pallidior*, Feng Siang, Shensu, China (F. C. M. 18929); *A. speciosus peninsulæ*, Tao Chou, Kansu, China (F. C. M. 19709); *A. sylvaticus sylvaticus*, Haida, Bohemia (U. S. N. M. 120950), St. Gallen, Switzerland (U. S. N. M. 84718) and England (Waterston).

NOTES.—This species is extremely close to *P. spinulosa*, differing only in the following details: It is somewhat smaller, female 1.1 mm. and male .6 mm., and distinctly more slender. The sternal plate (Fig. 120*B*) is more produced posteriorly, is more rounded and has the sides of the tapering portion concave instead of straight. The pleural plates differ constantly in having the ventral seta on the plates of the third segment much longer than the dorsal seta. The genitalia of the male (Fig. 120*E*)

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while of the same type as in *P. spinulosa* differ distinctly in detail, especially in the form of the parameres (*par*) which are much smaller and are almost entirely enclosed between the produced tips of the basal plate, and in the form of the pseudo-penis (*pp*) which is longer and has the lateral margins at the base less expanded. Fahrenholz (ref. cited) considers that the two species differ in the form of the head but I have been unable to see anything significant here.

I have not the slightest doubt that all the specimens above are referable to the same species, regardless of the differences in host. That this is not the *Pediculus affinis* of Burmeister seems quite certain as I have pointed out in an earlier number of this series (Part II, p. 78) but that it is the *Pediculus serratus* of the same author is perhaps open to doubt.

The original description of *Pediculus serratus* is as follows: "Capite breviore, genis post antennis incrassatis; lividus, abdomine in basi angusto, segmentis utrinque dilatatis, marginum abdominis serratum referentibus. Long 1/3. Hab. Mus musculus." It would seem from this that the species is a *Polyplax* rather than a *Hoplopleura* (the only other genus that is likely to enter into the question). And while there is the possibility that it is not the species at hand there seems no reason for concluding that it is not.

3. Polyplax reclinata (Nitzsch).

FIGS. 120*C*, 120*G*.

1864. *Pediculus reclinatus* Nitzsch, *Zeit. f. ges. Naturw.* 23:23.
1874. *Hæmatopinus reclinatus* (Nitzsch), Giebel, "Insecta Epizoa," p. 37.
1880. *Hæmatopinus reclinatus* (Nitzsch), Piaget, "Les Pediculines," p. 639.
1904. *Polyplax reclinata* (Nitzsch), Enderlein, *Zool. Ans.* 28: 142.
1904. *Hoplopleura reclinata* (Nitzsch), Enderlein, *ibid.* 28: 222.
1908. *Hoplopleura reclinata* (Nitzsch), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.
1910. *Hæmatopinus* (*Polyplax*) *spiniger reclinatus* (Nitzsch), Neumann, *Arch. de Parasit.* 13: 524–5; tf. 24.
1912. *Polyplax reclinata* (Nitzsch), Fahrenholz, *Zool. Ans.* 39: 55.
1912. *Polyplax reclinata* (Nitzsch), Fahrenholz, *Jahresb. des Niedersäch. Zool. Ver.* 2–4: 37–9; tf. 11–2; pl. 1, f. 12–13; pl. 2, f. 2–4; pl. 3, f. 7.
1916. *Polyplax reclinata* (Nitzsch), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 175.

PREVIOUS RECORDS. From *Sorex araneus*, Europe.

SPECIMENS EXAMINED. From *Crocidura cœrulea*, Rangoon, Burma (Nuttall); *Crocidura* sp., Atchebal, Valley of Kashmir (U. S. N. M. 201120); *Scutisorex* sp., Medjie, (American Museum Nat. History 48477); *Pachyura luzonensis*, Manila, Philippine Islands (U. S. N. M.).

NOTES.—Like *P. serrata* very closely resembling *P. spinulosa*, from which it differs only in minute, but apparently quite constant, details. The sternal plate (Fig. 120*C*) is much more produced posteriorly than in *spinulosa* and is very bluntly pointed and the sides of the produced portion are concave instead of straight. The pleural plates (Fig. 120*G*) have the setæ as long or longer than the plates themselves and characteristically the spiracles are much larger than in *spinulosa*, although in some specimens this character is not so marked. The genitalia of the male seem to be identical with those of *P. serrata* (Fig. 120*E*).

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I have not seen specimens of this from the type host but the hosts of the specimens examined are closely related to this and the description and figures given by Fahrenholz are sufficient to permit its reasonably certain identification.

4. Polyplax spinigera (Burmeister).

1839. *Pediculus spiniger* Burmeister, "Rhynchota," *Gen. Ins.* No. 9.
1842. *Hæmatopinus spiniger* (Burm.), Denny, "Mon. Anopl. Brit.,"p. 27; pl. 24, f. 6.
1864. *Pediculus spiniger* Burm., Nitzsch, *Zeits. f. ges. Naturw.* 23: 23.
1874. *Hæmatopinus spiniger* (Burm.), Giebel, "Insecta Epizoa," p. 39; pl. 2, f. 1.
1880. *Hæmatopinus spiniger* (Burm.), Piaget, "Les Pediculines," p. 637–8; pl. 52, f. 3.
1904. *Polyplax spinigera* (Burm.), Enderlein, *Zool. Ans.* 28: 142.
1908. *Polyplax spinigera* (Burm.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 14.
1909. *Hæmatopinus* (*Polyplax*) *spiniger* (Burm.), Neumann, *Arch. de Parasit.* 13: 524; tf. 24.
1916. *Polyplax spiniger* (Burm.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 176.

Previous Records. Known only from *Arvicola* (= *Hypudæus*) *amphibius* in Europe.

Notes.—The only Anopluran from the host of this species that I have seen is the specimen recorded under *P. spinulosa* which is one of those recorded by Denny as *Hæmatopinus spiniger* (Burm.). As I have noted I consider this specimen to be *P. spinulosa*. Whether or not *spinigera* is identical with *spinulosa* is a problem that can only be settled—if at all—by extended collecting from this host. Judging from the meager descriptions and the partial figures that are available it is at least certainly close to *spinulosa*. The figure of the pleural plates given by Neumann might very well have been made from specimens of the latter, and in fact possibly was, and according to this author the sternal plate is nearly identical with that of *spinulosa*.

The original figure and description of Burmeister are worthless and can not aid in making a decision. The figures of the two species given by Giebel indicate rather marked differences in the form of the head. Consequently, while I am personally inclined to the belief that the two are identical, there is the possibility that there is a distinct species on this host. Very probably *Hoplopleura acanthopus* occurs upon it, but this species hardly needs to be considered as the legs in all the figures indicate a *Polyplax*. If extended collecting should reveal only specimens of *spinulosa*, *spinigera* should be placed as a synonym.

5. Polyplax waterstoni Bedford.

Figs. 121, 122.

1919. *Polyplax waterstoni* Bedford, *Rept. Div. Vet. Res., Dept. Agric. Un. S. Africa* 6–7: 715–6; pl. 1, f. 1, 2, 4, 5.

Previous Records. From "several rats (two species)," Anderstepoort, Pretoria, South Africa.

Specimens Examined. From *Epimys peromyscus*, Molo, British East Africa (F. C. M. 17025).

Female (Fig. 121). Length 1.3 mm. *Head* nearly as broad as long, slightly rounded anteriorly; with the antennæ set close to the anterior

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margin; with prominent post-antennal angles and a much constricted occipital region, the lateral margins of the hind head nearly straight and parallel. *Thorax* about as long as the head, with angularly convex lateral margins; sternal plate (Fig. 122*B*) roughly half-oval; legs of ordinary form, the middle pair intermediate in stoutness between the anterior and posterior pairs.

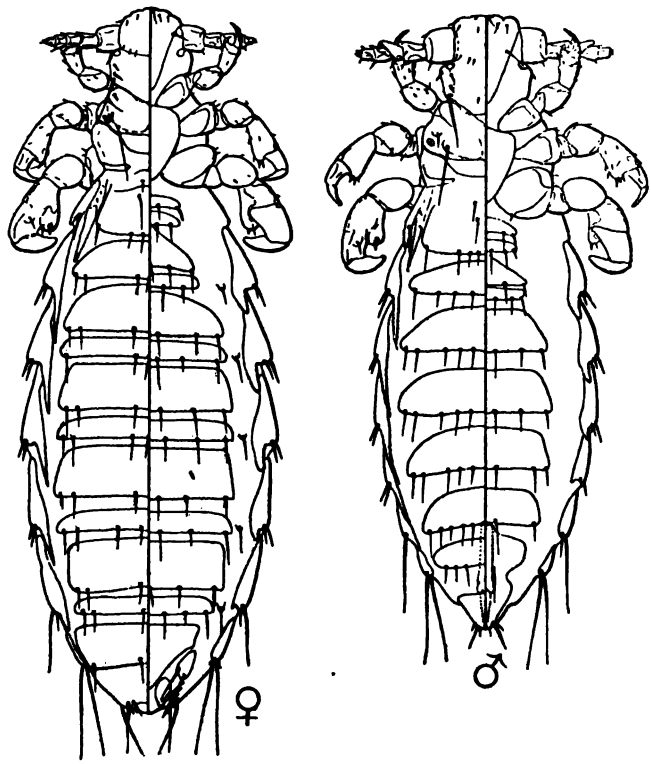

Fig. 121.—*Polyplax waterstoni* Bedford: male and female from *Epimys peromyscus*, Molo, British East Africa.

Pleural plates (Fig. 122*A*) as follows: plates of the second segment divided into two slender pieces, each of which bears a slender, tapering, free lobe and a small seta; plates of the third to sixth segments each with the dorsal posterior angle produced into a slender, tapering process which is more than half as long as the plate itself and with the ventral posterior angle produced into a shorter, broader and more bluntly pointed process; plates of the seventh segment with the dorsal process alone present; plates of the eighth segment small, without processes; the third to sixth plates

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bear a pair of small setæ, the seventh a pair of unequal length, the longest about as long as the plate, and the eighth a pair of long setæ; plates of the third to seventh pairs constricted somewhat at about the middle; lobes of all the plates with a scaly appearance.

Tergal and sternal plates of the abdomen strongly developed, extending almost from pleurite to pleurite and occupying the greater part of the surface, the anterior plate of each pair about twice as long as the

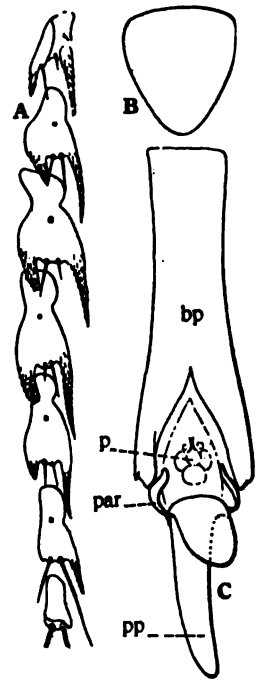

Fig. 122.—*Polyplax waterstoni* Bedford: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male; from specimens from *Epimys peromyscus*, Molo, British East Africa.

posterior; plates for the most part with five to seven very small setæ; ventral side with a single small seta on the third to seventh segments between the ends of the posterior sternal plate and the corresponding pleurite.

MALE (Fig. 121). Length .9 mm. *Head* slightly broader and slightly more truncate anteriorly than in the female; antennæ with the basal segment somewhat enlarged, the third segment strongly modified.

Tergal and sternal plates of the abdomen arranged in the typical manner, strongly developed, the tergal plates reaching almost from pleurite to pleurite and bearing for the most part ten small setæ, the sternal

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plates occupying about the median two-thirds and for the most part with six small setæ.

Genitalia (Fig. 122*C*) with the basal plate (*bp*) deeply cleft posteriorly, the parameres (*par*) very small, strongly curved, articulating at the apex with the relatively extremely large and stout pseudopenis (*pp*) which is bent dorso-ventrally into the form of a hook and is without lateral expansions at the base; penis (*p*) surrounded by weakly chitinized and ill-defined structures.

NOTES.—This is a very distinct species, the peculiar form of the pleural plates and the structure of the genitalia marking it at once. Its relationships seem to be most closely with the group that centers about *P. spinulosa.*

6. Polyplax præcisa (Neumann).

FIG. 123.

1901. *Hæmatopinus præcitus* Neumann, *Arch. de Parasit.* 5: 600–1 (part; typographical error for *præcisus*).

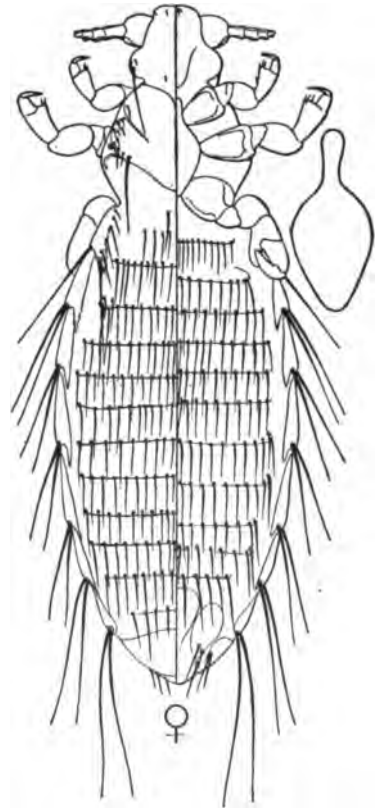

Fig. 123.—*Polyplax præcisa* (Neumann): female and sternal plate from a co-type specimen.

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1902. *Hæmatopinus præcisus* Neum., Neumann, *ibid.* **6**: 144; fig.
1904. *Polyplax præcisa* (Neum.), Enderlein, *Zool. Anz.* **28**: 143 (part).
1908. *Polyplax* (*?*) *præcisa* (Neum.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 13 (part).
1909. *Hæmatopinus* (*Polyplax*) *præcisus* Neum., Neumann, *Arch. de Parasit.* **13**: 523 (part).
1916. *Hæmatopinus* (*Polyplax*) *præcisus* Neum., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 178 (part).
1919. *Polyplax præcisa* (Neum.), Fahrenholz, *Jahresb. des Niedersäch. Zool. Ver.* **5–10**: 25–6.

PREVIOUS RECORDS. Known only from the original record, from "gros rats" in Abyssinia.

SPECIMENS EXAMINED. A single female from the type specimens of Neumann, received through the kindness of Professor A. Martin of the Ecole Veterinaire of Toulouse, and single female from Budarna Kwepa, Uganda, labeled as from *Rattus coucha ugandæ,* received from the British Museum, which is apparently this species.

FEMALE (Fig. 123). Length 1.75 mm. *Head* nearly as broad as long, almost truncate anteriorly, with the antennæ set close to the anterior margin, with prominent post-antennal angles and a strongly constricted occipital region, the lateral margins of the hind head bulging and rounded; antennæ with the basal segment considerably enlarged. *Thorax* considerably longer than the head, with the lateral margins strongly convex; dorsally with a submarginal series of short setæ cephalad of the spiracles; sternal plate (Fig. 123) elongate oval with a short, handle-like projection anteriorly; legs of ordinary form, the middle pair longer than, but not so stout as, the posterior.

Pleural plates difficult to work out from the specimen examined but apparently as follows: plates of the second segment probably divided longitudinally, each lobe with a single very long seta and the dorsal lobe with several small setæ along its dorsal margin; plates of the third to seventh segments each with a short, tapering process at each posterior angle and with a pair of very long setæ; plates of the eighth segment without teeth and likewise with a pair of long setæ.

Tergal and sternal plates of the abdomen arranged as usual but their extent not clearly determinable from the specimen examined, with for the most part as many as sixteen to twenty-four small, slender setæ.

NOTES.—In my catalogue of the Anoplura (1916) I called attention to the fact that the *Hæmatopinus præcisus* of Neumann appeared to include two species belonging to different genera. Fahrenholz (1919) accepted this conclusion and named the species *Hoplopleura neumanni,* for the "female" described by Neumann, retaining the name *Polyplax præcisa* for the "male."

The slide that I have received from Professor Martin contains three specimens and is labeled as containing a male and two females but all the specimens are females.

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The single female of the one species represents *Polyplax præcisa* and it appears that Neumann did not have the male of this species, which is therefore unknown.

Unfortunately this single specimen of *præcisa* is somewhat difficult to study and the accompanying figure is not entirely complete. The species should be readily recognizable, however, by the peculiar form of the head, the presence of the numerous small, submarginal setæ on the dorsum of the thorax and the long setæ of all the pleural plates. It may be regarded as the type form of a small series of species that follow, all of which are from members of the subfamily *Gerbillinæ*.

7. Polyplax tateræ n. sp.

FIGS. 124, 125*B-D*.

SPECIMENS EXAMINED. One male (the holotype) and two females from *Tatera vicina*, Mt. Sukenya, British East Africa (F. C. M. 16704). The host is a *Murid* of the subfamily *Gerbillinæ*.

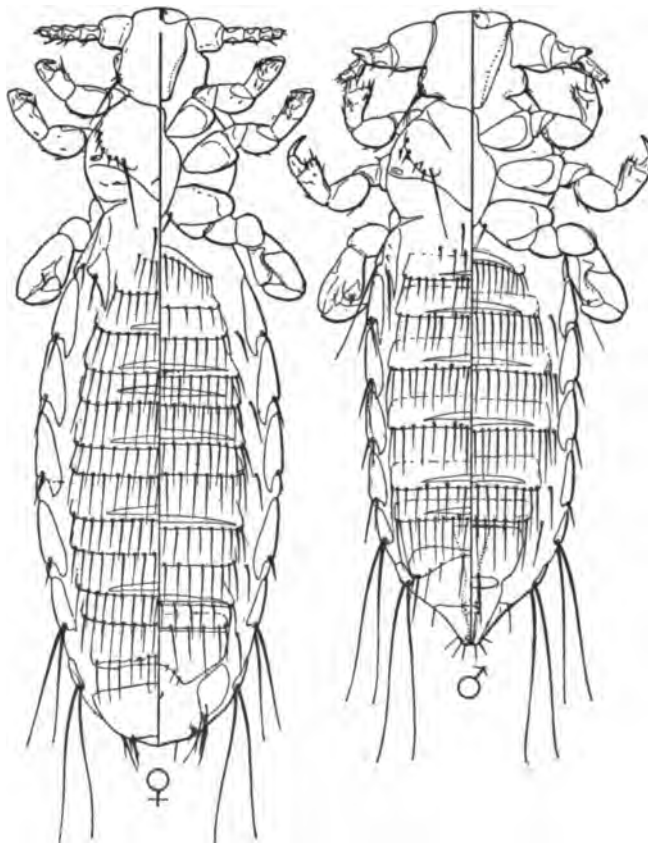

Fig. 124.—*Polyplax tateræ* n. sp., male and female.

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FEMALE (Fig. 124). Length 1.4 mm. *Head* nearly as broad as long, almost truncate in front of the antennæ which are set close to the anterior margin; with prominent post-antennal angles and a strongly constricted occipital region and with the lateral margins of the hind head straight and very slightly convergent; antennæ with the basal segment somewhat enlarged. *Thorax* about as long as the head, with the lateral margins strongly and roundly convex and with a dorsal, submarginal series of small setæ cephalad of the spiracles; sternal plate (Fig. 125*C*) elongate oval, with a handle-like process anteriorly; legs of ordinary form.

Pleural plates (Fig. 125*B*) as follows: plates of the second segment distinctly divided longitudinally, the dorsal portion with a tapering lobe, each portion with a slender seta; plates of the third to sixth segments with each posterior angle produced into a tooth, that of the ventral side somewhat the broader, and each with a pair of slender setæ which are about as long as the plate itself; plates of the seventh and eighth segments without pronounced teeth and with the usual long setaæ.

Tergal and sternal plates reaching nearly from pleurite to pleurite but except for a slender central portion not strongly chitinized, bearing for the most part as many as twenty slender setæ.

MALE (Fig. 124). Length 1.2 mm. *Head* relatively broader than in the female and with the hind head shorter; antennæ with the basal segment much enlarged and with the third segment strongly modified.

Tergal and sternal plates strongly developed, the latter departing from the usual arrangement, there being not more than one plate on each segment; all the plates quite large, reaching nearly from pleurite to pleurite, with a more strongly chitinized central portion as in the female and bearing for the most part as many as eighteen or twenty slender setæ.

Genitalia (Fig. 125*D*) with the basal plate (*bp*) large, expanded anteriorly, the parameres (*par*) very short and quite broad, articulating with the stout, wedge-shaped pseudopenis (*pp*).

NOTES.—This species is evidently quite close to *P. præcisa*, the female differing chiefly in the short setæ of the pleural plates and the angular hind head. The male resembles somewhat the male of *P. werneri* but differs especially in the form of the sternal plate.

8. **Polyplax biseriata** n. sp.

FIGS. 125*A*, 126.

SPECIMENS EXAMINED. Several males and females (holotype a male) from *Tatera bohmi varia*, South Guaso Nyiro, British East Africa (U. S. N. M. 162250). Also a male and female from *Tatera* sp., Bothaville, Orange Free State (Bedford).

FEMALE (Fig. 126). Length 1.3 mm. *Head* somewhat longer than

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wide, slightly rounded in front of the antennæ which are set close to the anterior margin; with distinct post-antennal angles and a strongly constricted occipital region, the lateral margins of the hind head nearly straight and parallel; antennæ with the basal segment not strongly swollen. *Thorax* about as long as the head, with the lateral margins roundly convex, dorsally with a pair of small submarginal setæ cephalad of the spiracles; sternal plate oval, with a slight anterior process.

Pleural plates (Fig. 125*A*) as follows: plates of the second segment

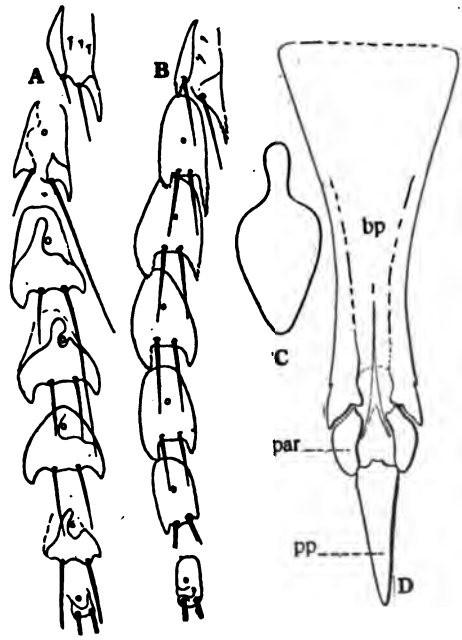

Fig. 125.—*Polyplax tateræ* n. sp.: *B*, pleural plates; *C*, sternal plate; *D*, genitalia of male. *Polyplax biseriata* n. sp.: *A*, pleural plates.

distinctly divided longitudinally, the dorsal part with a slender, tapering process and each part with a slender seta; plates of the second to sixth segments each with a broad tooth at each posterior angle, those of the third segment divided longitudinally, those of the third and fourth segments each with the dorsal seta about twice as long as the plate itself and the ventral seta shorter than the plate, those of the fifth and sixth segments with the setæ about as long as the plate; plates of the seventh and eighth segments small, each with a pair of long setæ.

Tergal and sternal plates of the abdomen very small, extending across not more than the median half of the abdomen, bearing for the most part

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eight to ten slender setæ. On the dorsal side between the ends of each plate on the fourth to eighth segments and the corresponding pleurites are one or two setæ and on the ventral side are one to three setæ on the third to seventh segments in a similar situation.

MALE (Fig. 126). Length 1.1 mm. *Head* relatively broader and more

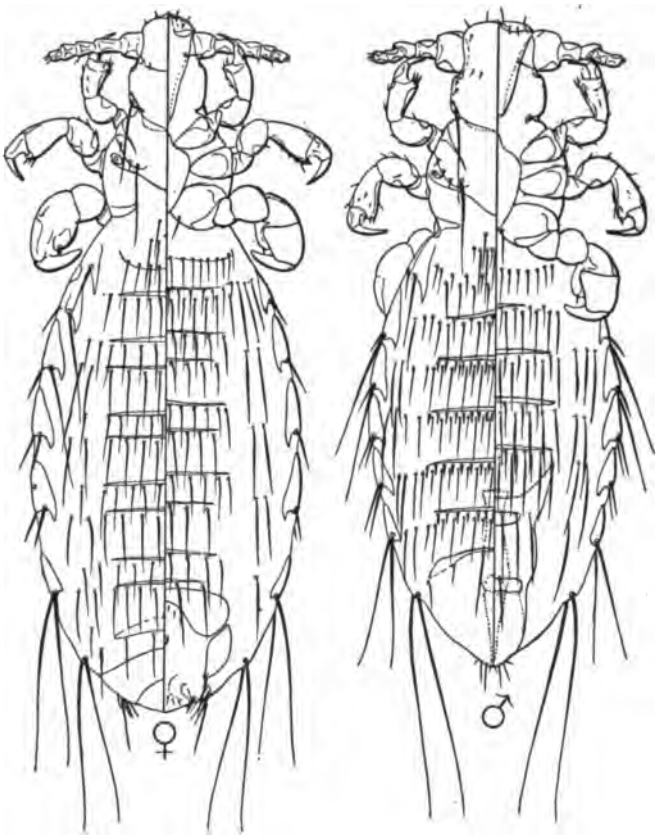

Fig. 126.—*Polyplax biseriata* n. sp., male and female.

nearly truncate anteriorly than in the female; antennæ with the basal segment much enlarged and with the third segment strongly modified.

Tergal and sternal plates weakly developed, occupying about the median half of the abdomen, departing from the typical arrangement in that there is not more than one plate on any of the sternites. Setæ of the dorsum arranged in a double row on the fourth to seventh segments, the posterior row extending entirely across the segment and consisting of as many as twenty or more setæ of various lengths, the anterior row confined to the region of the tergal plate and consisting of about twenty small,

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stout setæ. Setæ of the ventral side arranged in an irregularly double row on each segment.

Genitalia practically as in *P. tateræ* (see Fig. 125*D*).

NOTES.—This species is certainly a member of the *præcisa* group but is readily distinguishable by the weakly developed tergal and sternal plates of the abdomen and the arrangement of the setæ in the male.

9. Polyplax werneri (Glinkiewicz).

FIG. 127.

1907. *Eremophthirius werneri* Glinkiewicz, *Sitzb. d. Kaiserl. Akad. d. Wissens. Wien, Math. Natur. Klasse* **116**: 381–3; figs.

1910. *Hoplopleura* (?) *werneri* (Glink.), Mjöberg, *Ark. f. Zool.* **6**: 164.

1916. *Polyplax werneri* (Glink.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 177.

PREVIOUS RECORDS. From *Pachyuromys duprasi,* Natron Valley, Egypt.

SPECIMENS EXAMINED. Two males from the above host and locality taken from skins in the British Museum by Mr. James Waterston.

MALE (Fig. 127*A*). Length .7 mm. *Head* slightly broader than

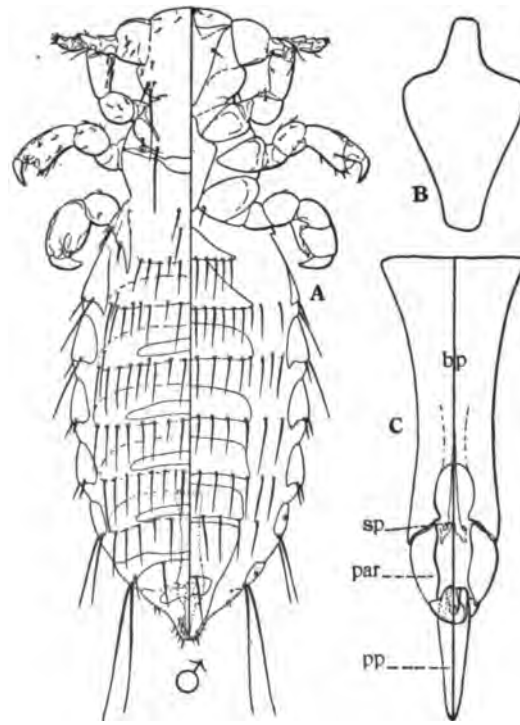

Fig. 127.—*Polyplax werneri* (Glink.): *A*, male; *B*, sternal plate; *C*, genitalia.

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long, almost truncate in front of the antennæ, which are set close to the anterior margin; with prominent post-antennal angles and a strongly constricted occipital region, the lateral margins of the hind head rounded convex and strongly convergent; antennæ with the basal segment much enlarged and with the third segment strongly modified. *Thorax* about as long as the head, with the lateral margins roundly convex; sternal plate (Fig. 127*B*) triangular, the posterior end blunt, the anterior end with a short median process; legs of ordinary form.

Pleural plates with the posterior angles but little or not at all produced; plates of the second segment divided longitudinally, each lobe with a small seta; plates of the third and fourth segments each with a long dorsal seta and a smaller ventral, those of the fifth and sixth segments with a pair of small setæ and those of the seventh and eighth with the usual long setæ.

Tergal and sternal plates large but rather weakly chitinized, the former occupying nearly the entire width of the abdomen, the latter the median half. Tergal plates with as many as sixteen to twenty small setæ. Sternal plates departing from the usual arrangement in that there is but a single plate on each segment, the plates with for the most part eight to ten setæ, the third to seventh segments with one or two setæ between the ends of the sternal plates and the corresponding pleurite.

Genitalia (Fig. 127*C*) with the basal plate (*bp*) deeply cleft posteriorly, the parameres (*par*) short and stout, articulating at their tips with the short, wedge-shaped pseudopenis (*pp*).

FEMALE. According to the original description the female is 1.2 mm. long. The description and figures contain nothing that would aid especially in its recognition.

NOTES.—The two males of this species that I have examined were received as a loan from Mr. James Waterston who very kindly examined the skins of its host in the British Museum collection. The species is evidently one of the *præcisa* group, distinguishable chiefly by the form of the head and sternal plate and the extent of the tergal and sternal plates of the abdomen.

10. **Polyplax gerbilli** n. sp.

FIGS. 128, 129.

SPECIMENS EXAMINED. A male and three females from *Gerbillus pyramidum*, Khartum, Egypt (S. Hirst, coll.). Holotype a female. These specimens were received as a loan from the British Museum, through the kindness of Mr. Waterston, and are deposited in the collections of that institution.

FEMALE (Fig. 128). Length 1.1 mm. *Head* slightly longer than wide, slightly rounded in front of the antennæ which are set close to the

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anterior margin; with very slight post-antennal angles, the lateral margins of the hind head strongly curved and little or not at all convergent; antennæ with the basal segment not exceptionally enlarged. *Thorax* about as long as the head, with the lateral margins angularly convex, dorsally

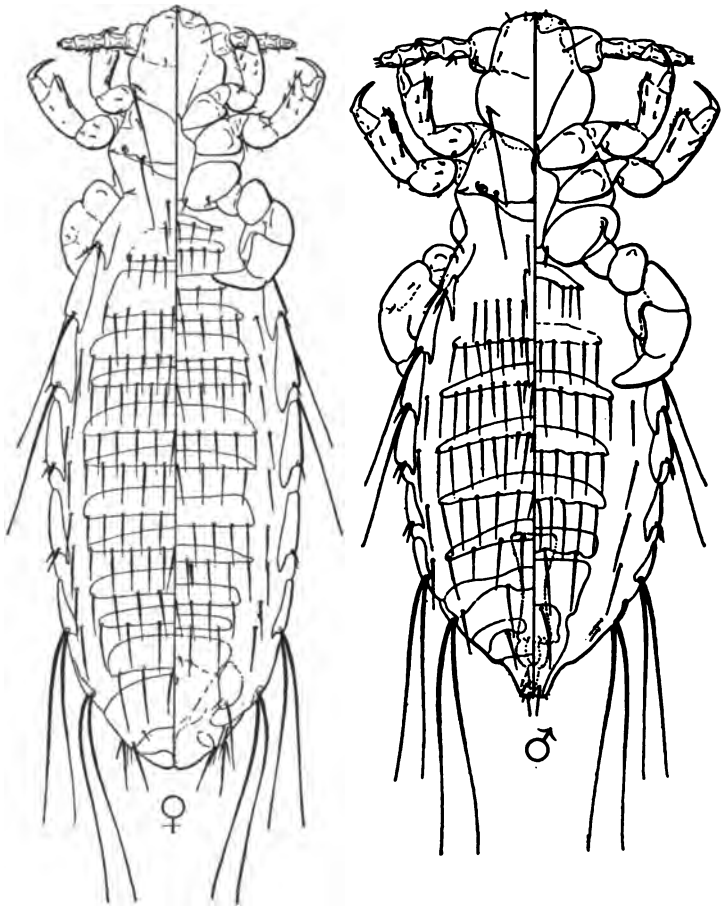

Fig. 128.—*Polyplax gerbilli* n. sp., male and female.

without submarginal setæ cephalad of the spiracles; sternal plate (Fig. 129*B*) with a very slight anterior process and with the posterior end blunt.

Pleural plates as follows: plates of the second segment divided longitudinally, although the division is very faint, the dorsal part with a slender, tapering process and each part with a small seta; plates of the third to sixth segments each with a small tooth at the dorsal posterior angle and a much broader and longer tooth at the ventral angle, those of the third and fourth segments with a short ventral seta and a very long, slender

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dorsal seta, those of the fifth and sixth segments with a pair of short setæ; plates of the seventh and eighth segments with the usual long slender setæ and without teeth.

Tergal and sternal plates of the abdomen quite large and occupying the greater part of the width of the abdomen, the tergal plates bearing for the most part ten to twelve slender setæ, the sternal plates bearing for the most part seven or eight.

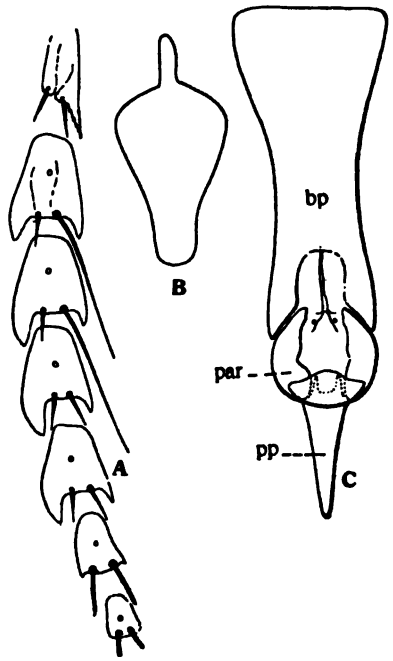

Fig. 129.—*Polyplax gerbilli* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

MALE (Fig. 128). Length .8 mm. *Head* almost as in the female, the basal segment of the antennæ not unusually enlarged, the third segment definitely but not conspicuously modified.

Tergal and sternal plates of the abdomen quite strongly developed, the rows of setæ arranged in the normal manner except that there is not more than one row on each sternite. Dorsally the rows contain for the most part ten to sixteen slender setæ and ventrally for the most part ten.

Genitalia (Fig. 129*C*) very similar to those of *P. werneri*, the basal plate (*bp*) quite large and broad, slightly expanded anteriorly, the parameres (*par*) very short and rather broad, strongly curved and articulating

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at the tips with the stout, wedge-shaped pseudopenis (*pp*) which is quite strongly expanded at the base.

NOTES.—This species is another of the *præcisa* group, which in the male seems most closely to resemble *P. werneri*. It differs from the latter, however, especially in the form of the head, the much less modified antennæ and the broad ventral tooth of the pleural plates. The female is distinguishable from any of the other species of the group especially by the form of the head and the character of the pleural plates.

11. **Polyplax stephensi** (Christophers and Newstead).

FIGS. 130, 131.

1906. *Hæmatopinus stephensi* Christophers and Newstead, *Thompson Yates and Johnston Laboratories Rept.* (n. s.) 7: 3–6; pl. 1.

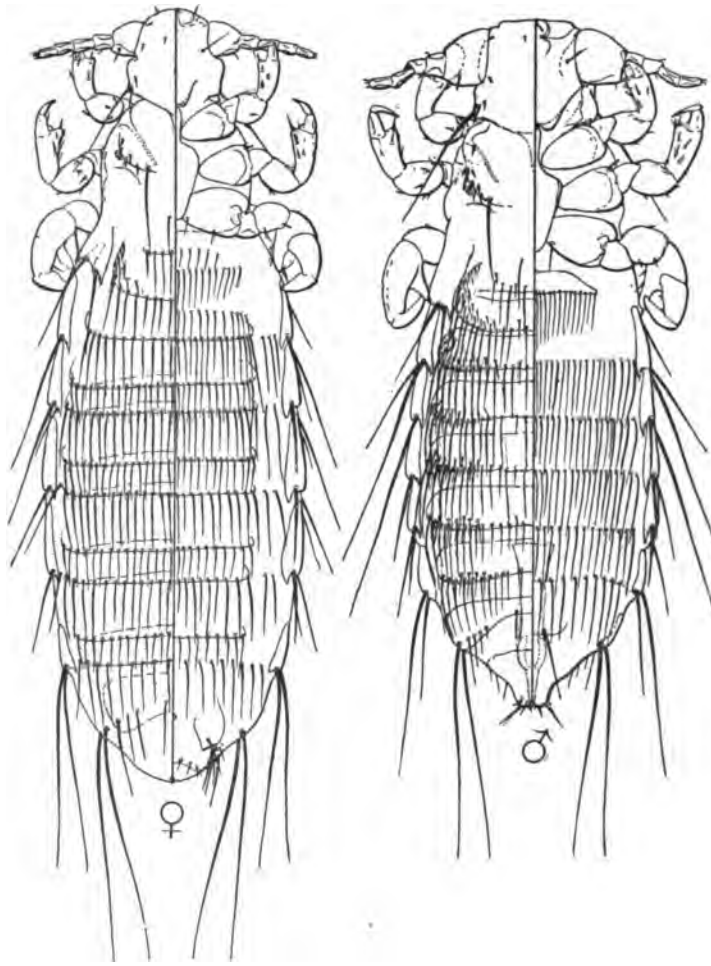

Fig. 130.—*Polyplax stephensi* (Chr. and Newst.), male and female, from co-types.

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1909. *Hæmatopinus* (*Polyplax*) *stephensi* Chr. and Newst., Neumann, *Arch. de Par.* 13: 525–6; f. 25.

1913. *Hæmatopinus* (*Polyplax*) *stephensi* Chr. and Newst., Patton and Cragg, "Medical Entomology," pp. 550–1; pl. 68, f. 4–6.

1915. *Polyplax stephensi* Chr. and Newst., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 177.

PREVIOUS RECORDS. Originally recorded from *Tatera* (= *Gerbillus*) *indica*, India, without more precise indication of locality. Co-type specimens are labeled as from Madras. Also recorded by Patton and Cragg from India.

SPECIMENS EXAMINED. A male and a female, co-types; several specimens from the type host, "Dharwar District"; "Central India, Hoshangabad District"; "Central India." All these are in the British Museum Collection and were received as a loan through the kindness of Mr. James Waterston.

FEMALE (Fig. 130). Length 1.7 mm. *Head* about as long as wide, slightly rounded anteriorly, with the antennæ set close to the anterior margin; with moderately prominent post-antennal angles and a much constricted occipital region, the lateral margins of the hind head nearly straight and parallel. *Thorax* somewhat longer than the head, the lateral margins roundly convex, with a dorsal, series of three or four small setæ cephalad of the spiracle; sternal plate (Fig. 131) spatulate, the angles rounded.

Pleural plates (Fig. 131*A*) as follows: those of the second segment faintly divided into two lobes, each of which bears a long, slender seta; those of the third to sixth segments each with a very small tooth at the dorsal apical angle and a slightly larger tooth at the ventral angle and with a pair of slender setæ as long as the plate itself except on the plates of the third and fourth segments where the dorsal seta is about twice as long as the plate; plates of the seventh segment with a very small tooth at each angle, those of the eighth without teeth, each pair with the usual long setæ.

Tergal and sternal plates of the abdomen arranged in the usual manner. In the specimens examined they appear to be quite weakly chitinized but occupy nearly the entire width of the abdomen and both dorsally and ventrally bear for the most part from twenty to thirty slender setæ, those of the anterior plate on each segment being slightly shorter than those of the posterior plate. The second plate of the second tergite bears several small setæ at each end.

MALE (Fig. 130). Length 1.3 mm. *Head* relatively broader than in the female with the hind head shorter and the anterior margin more nearly truncate; antennæ with the first segment greatly enlarged and with the third segment strongly modified.

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Tergal plates of the abdomen arranged in the normal manner, large, occupying nearly the entire width of the abdomen, bearing for the most part as many as thirty or more slender setæ. In addition to these the plates of the second to seventh segment bear several small setæ at each end and in some specimens these small setæ extend entirely across the segment. These small setæ are especially numerous on the second and third segments. Sternal plates apparently not developed or at the most very weakly so in the specimens examined, the sternal setæ departing from the typical

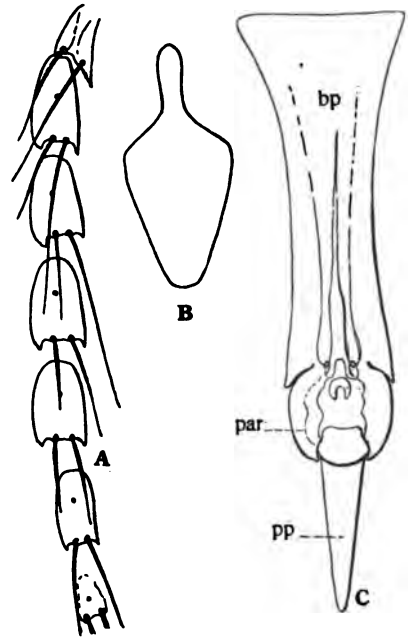

Fig. 131.—*Polyplax stephensi* (Chr. and Newst.): *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male; from co-types.

arrangement in that there is but a single row to each segment, these rows containing for the most part from thirty to forty slender setæ.

Genitalia (Fig. 131*C*) with the basal plate (*bp*) large, somewhat expanded anteriorly, the parameres (*par*) short and strongly curved, articulating at the apex with the stout, wedge-shaped pseudopenis (*pp*) which is slightly expanded at the base.

NOTES.—This species is another of the *præcisa* group distinguishable especially in the male by the small setæ of the abdominal tergites and in the female by the form of the head and pleural plates and the numerous setæ of the abdomen.

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12. **Polyplax chinensis** n. sp.

FIGS. 132, 133.

SPECIMENS EXAMINED. Several males and females from *Meriones auceps,* Shensi, China (U. S. N. M. 172573). Holotype a female.

FEMALE (Fig. 132). Length 1.4 mm. *Head* about twice as long as wide, acutely rounded in front of the antennæ which are set well forward; with slight post-antennal angles and a markedly constricted occipital

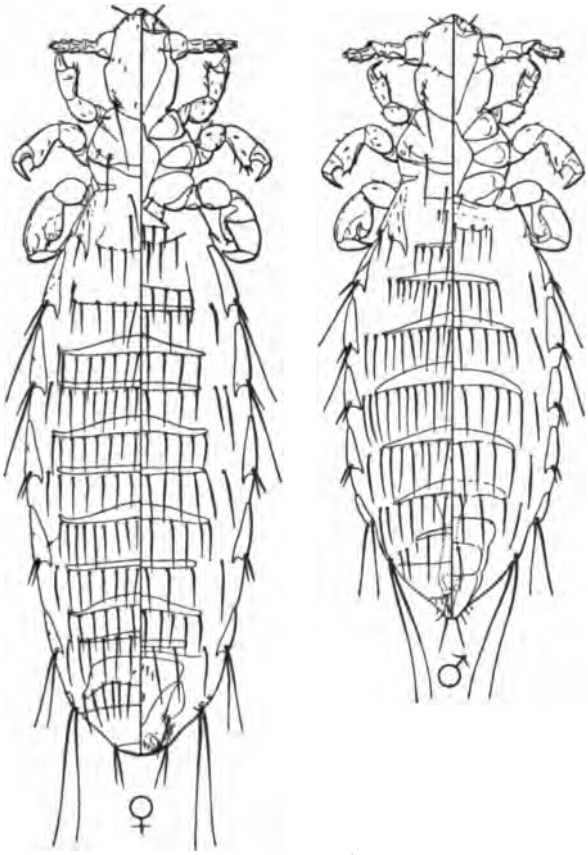

Fig. 132.—*Polyplax chinensis* n. sp., male and female.

region, the lateral margins of the hind head nearly straight and slightly convergent; antennæ with the first segment not conspicuously enlarged. *Thorax* slightly shorter than the head, with convex lateral margins; sternal plate (Fig. 133*B*) elongate, triangular, bluntly pointed posteriorly and with a slight anterior process; legs of ordinary form.

Pleural plates (Fig. 133*A*) as follows: plates of the second segment

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distinctly divided longitudinally, each lobe with an acute process and bearing a small seta; plates of the third to seventh segments triangular, with a slight tooth at each posterior angle, those of the third segment divided longitudinally; plates of the third and fourth segments with the dorsal seta longer than the plate itself, the shorter seta quite small; plates of the fifth and sixth segments with a pair of small setæ and of the seventh and eighth with the usual long setæ.

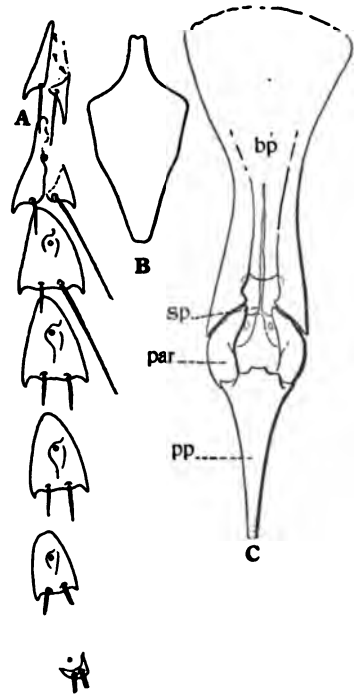

Fig. 133.—*Polyplax chinensis* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

Tergal and sternal plates of the abdomen reaching nearly from pleurite to pleurite but quite slender, the anterior plate of each pair somewhat stouter than the posterior, the tergal plates bearing for the most part as many as twelve to sixteen slender setæ, the sternal plates eight to ten. Between the ends of the posterior plate on the fourth to seventh tergites and the third to seventh sternites and the corresponding pleurites is a single seta.

MALE (Fig. 132). Length 1.1 mm. *Head* practically as in the female, the first segment of the antennæ slightly enlarged, the third modified.

Tergal and sternal plates of the abdomen well developed, reaching

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nearly from pleurite to pleurite but slender, the tergal plates with as many as sixteen to eighteen setæ, the sternal plates with eight or ten. Sternal plates departing from the typical arrangement in that there is but one on each sternite.

Genitalia (Fig. 133*C*) with the basal plate (*bp*) constricted medially, the parameres (*par*) short and broad, the pseudopenis (*pp*) nearly half as long as the basal plate, wedge-shaped.

NOTES.—This species is another of the *præcisa* group, distinguishable chiefly by the rather slender head, the form of the tergal and sternal plates of the abdomen, the sternal plate of the thorax and the setæ on the pleural plates.

13. Polyplax otomydis Cummings.

FIGS. 134, 135.

1912. *Polyplax otomydis* Cummings, *Bull. Ent. Res.* **3**: 395–7; tf. 2.
1914. *Polyplax otomydis* Cumm., Waterston, *Ann. S. African Mus.* **10**: 275.
1915. *Polyplax otomydis* Cumm., Kellogg and Ferris, *Ann. Durban Mus.* **1**: 150.
1916. *Polyplax otomydis* Cumm., Ferris, *ibid.* **1**: 240; tf. 23A.
1916. *Polyplax otomydis* Cumm., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 173.
1919. *Polyplax otomydis* Cumm., Bedford, *Rept. Div. Vet. Res., Dept. Agric. Un. S. Africa* **5**: 715.

PREVIOUS RECORDS. Types from *Otomys irroratus tropicalis,* Mt. Kenya, British East Africa. Also from *O. irroratus,* Anderstepoort, Pretoria, (Bedford) and Mfongosi, Zululand (Kellogg and Ferris; Ferris) and *O. brantsi luteolus* without indication of locality (Waterston).

SPECIMENS EXAMINED. Those upon which the above records by Kellogg and Ferris were based and others from *Otomys angoniensis elassodon,* Naivasha, British East Africa (F. C. M. 16687).

FEMALE (Fig. 134). Length 1.5 mm. *Head* slender, more than twice as long as wide, acute in front of the antennæ which are set somewhat back from the apex; with slight post-antennal angles and a distinctly constricted occipital region, the lateral margins of the hind head straight and slightly convergent; antennæ with the first segment but little enlarged. *Thorax* about three-fourths as long as the head, the lateral margins angularly convex; sternal plate (Fig. 135*B*) spatulate.

Pleural plates (Fig. 135*A*) as follows: plates of the second segment distinctly divided longitudinally into small linear pieces, each with a short seta; plates of the third to sixth segments triangular, each with the ventral angle somewhat produced and each with a pair of short setæ except those of the fourth segment which have the dorsal seta about twice as long as the plate itself; plates of the seventh and eighth segments small, bearing the usual long setæ.

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Tergal and sternal plates of the abdomen strongly developed, occupying about three-fourths of the width of the body and covering the greater part of the surface. Tergal plates with for the most part eight to ten slender setæ, the sternal plates with seven or eight.

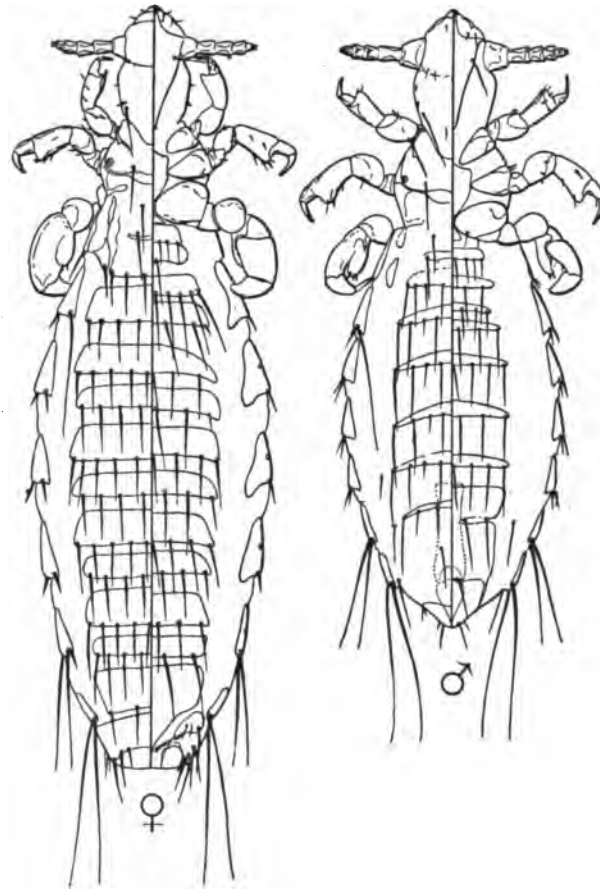

Fig. 134.—*Polyplax otomydis* Cumm., male and female from specimens from *Otomys irroratus*, Mfongosi, Zululand.

MALE (Fig. 134). Length 1 mm. *Head* as in the female, the antennæ not at all modified.

Tergal and sternal plates arranged in the typical manner, occupying a little more than the median half of the body, rather slender, bearing for the most part six to eight setæ.

Genitalia (Fig. 135*C*) with the basal plate (*bp*) quite broad, the posterior angles produced; parameres (*par*) quite long and tapering,

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enclosing the wedge-shaped pseudopenis (*pp*) and the small statumen penis (*sp*).

NOTES.—This species may be regarded as the type of a group which is distinguished by the form of the genitalia of the males, the pseudopenis being enclosed between the parameres instead of being articulated with their tips as in the groups of *P. spinulosa* and *P. præcisa*.

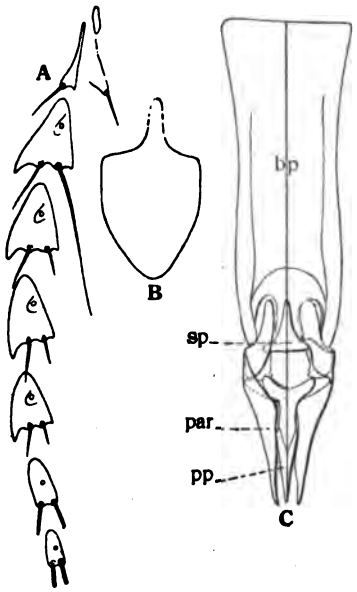

Fig. 135.—*Polyplax otomydis* Cumm.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male; from specimens from *Otomys irroratus*, Mfongosi, Zululand.

14. Polyplax cummingsi Ferris.

FIGS. 136, 137.

1916. *Polyplax gracilis* Fahrenholz, Ferris, *Ann. Durban Mus* 1: 240; tf. 23C, 24 (misidentification).

1916. *Polyplax cummingsi* Ferris, *ibid.* 1: 240–3; tf. 25, 26A.

PREVIOUS RECORDS. Originally described from the female only from *Dasymys incomtus*, Mfongosi, Zululand. Also recorded as *P. gracilis* Fahr. from *Mus chrysophilus* at the same place.

SPECIMENS EXAMINED. Those upon which the above records were based and others from *Dasymys incomtus helukus*, Kaimosi, British East Africa (U. S. N. M. 183151), an allotype has been selected from the latter lot.

FEMALE (Fig. 136). Length 1.3 mm. *Head* somewhat longer than wide, acutely rounded in front of the antennæ, which are set somewhat

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back from the apex, with the post-antennal angles rounded and with a distinctly constricted occipital region, the lateral margins of the hind head, sub-parallel; antennæ with the first segment but little swollen. *Thorax* slightly shorter than the head, the lateral margins convex; sternal plate (Fig. 137*B*) spatulate; anterior and middle legs of practically the same

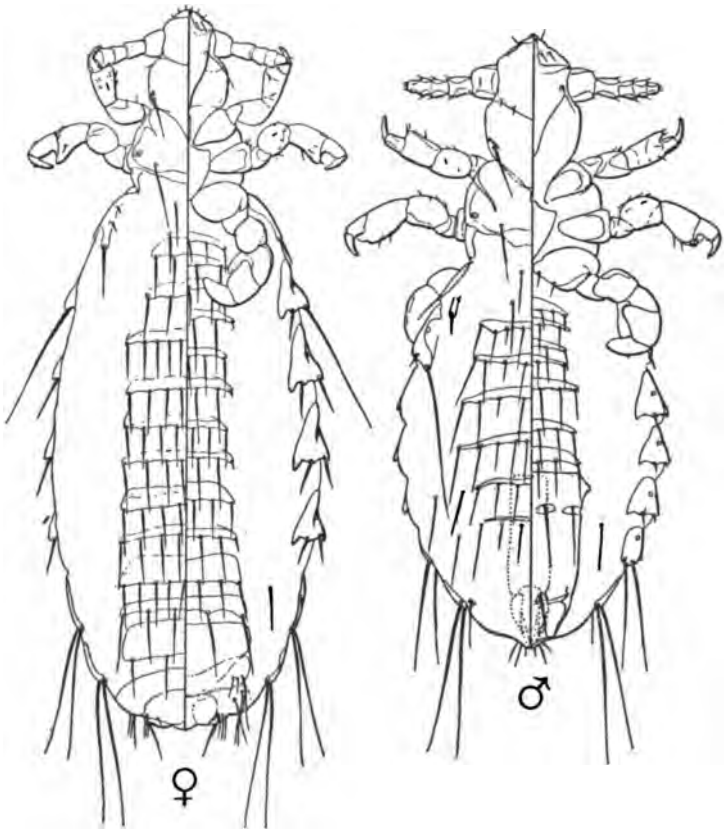

Fig. 136.—*Polyplax cummingsi* Ferris, male and female, from the types.

size, posterior legs stout, the trochanter attached to the coxa in such a manner that normally the legs are disposed beneath the abdomen.

Pleural plates (Fig. 137*A*) as follows: plates of the second segment divided into two small pieces, each with a short seta; plates of the third to sixth segments triangular, the ventral posterior angle produced into a tooth, each with a pair of short setæ except those of the third segment which have the dorsal seta about twice as long as the plate itself; plates of the seventh and eighth segments small, with the usual long setæ.

Tergal and sternal plates of the abdomen occupying about the median

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half, rather weakly chitinized, the tergal plates with for the most part eight to ten slender setæ, the sternal plates with four to six.

MALE (Fig. 136). Length .9 mm. *Head* as in the female, the antennæ not modified. *Pleural plates* as in the female except that the setæ are somewhat smaller.

Tergal and sternal plates of the abdomen slender, the tergal plates occupying slightly more than one-half of the width of the body, the sternal plates slightly less than half, the sternal plates arranged in the typical

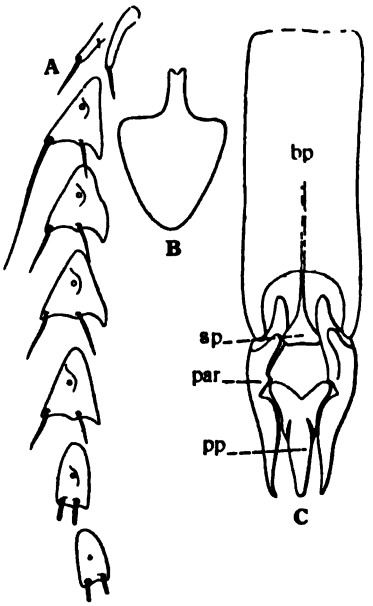

Fig. 137.—*Polyplax cummingsi* Ferris: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male; from the types.

manner. Tergal plates with for the most part six to eight small setæ of variable lengths, the sternal plates with four to six.

Genitalia (Fig. 137*C*) with the basal plate (*bp*) short and broad, the posterior angles produced; parameres (*par*) a little more than half as long as the basal plate, tapering, sub-parallel, enclosing the wedge-shaped pseudopenis (*pp*) and a small statumen penis (*sp*).

NOTES.—For reasons which are now entirely incomprehensible I at one time (ref. cited) assigned some specimens of this species to *Polyplax gracilis* and described others as *P. cummingsi*. I am not now able to see any special differences between these two lots nor is it at all probable that the species is *P. gracilis*, in fact upon re-reading the description of the latter it becomes evident that it is not.

On the basis of the character of the genitalia *P. cummingsi* belongs to the group of *P. otomydis*, differing from the latter chiefly in the lesser extent of the tergal and sternal plates of the abdomen in the female and in the form of the genitalia of the male.

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15. Polyplax jonesi Kellogg and Ferris.

FIGS. 138, 139.

1915. *Polyplax jonesi* Kellogg and Ferris, *Ann. Durban Mus.* **1**: 151–2; pl. 15, f. 3–3e.

1916. *Polyplax jonesi* K. and F., Ferris, *ibid.* **1**: tf. 23B, 26B.

1916. *Polyplax jonesi* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Sci.* (4) **6**: 173.

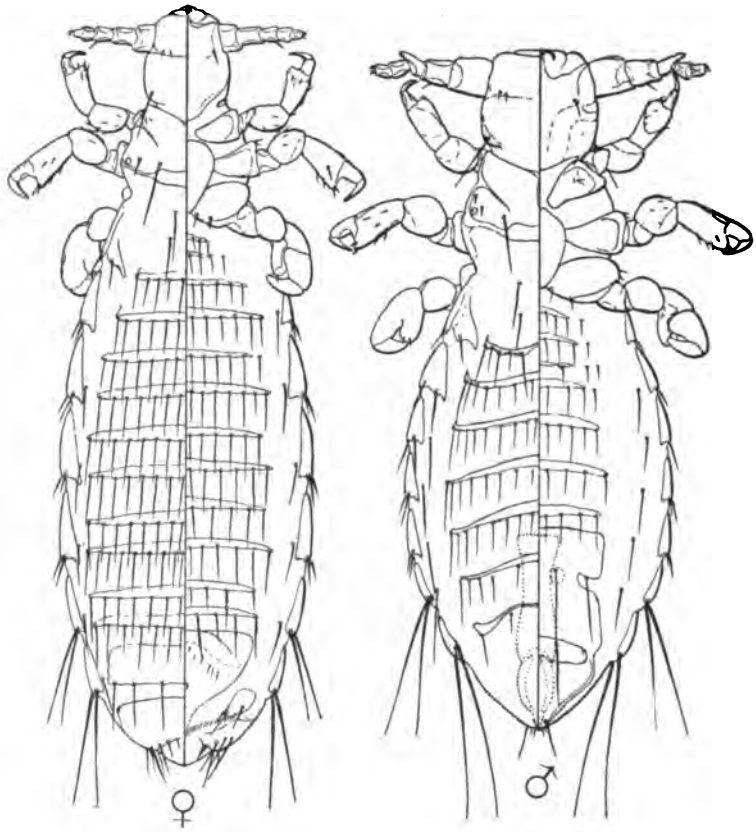

Fig. 138.—*Polyplax jonesi* Kellogg and Ferris, male and female; from the types.

PREVIOUS RECORDS. From *Saccostomus campestris,* Mfongosi, Zululand.

SPECIMENS EXAMINED. Only as above recorded.

FEMALE (Fig. 138). Length 1.4 mm. *Head* slightly longer than wide, acutely rounded in front of the antennæ which are set close to the apex; with the post-antennal angles almost obsolete but with a distinctly constricted occipital region, the lateral margins of the hind head almost parallel; antennæ with the first segment not especially enlarged. *Thorax*

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slightly shorter than the head, with the lateral margins convex; sternal plate (Fig. 139*B*) oval; legs of ordinary form, the middle pair larger than the first and somewhat longer, although much less stout, than the posterior pair.

Pleural plates (Fig. 139*A*) as follows: plates of the first segment divided into a narrow ventral and a broader dorsal piece, each with a small seta; plates of the third to sixth segments triangular, with each posterior angle produced into a very slight tooth, that of the ventral side

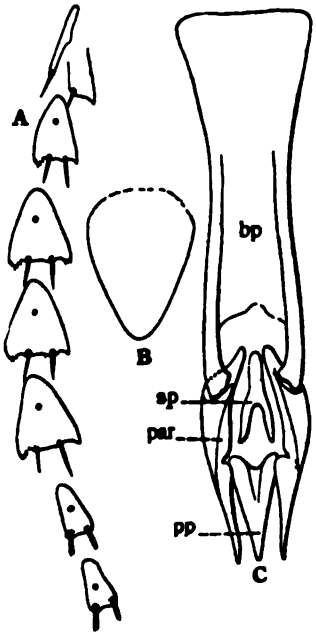

Fig. 139.—*Polyplax jonesi* Kellogg and Ferris: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male; from the types.

broader and somewhat frayed, each plate with a pair of small, stout setæ; plates of the seventh and eighth segments smaller, each with the usual pair of long setæ.

Tergal and sternal plates of the abdomen reaching almost from pleurite to pleurite but rather slender, the tergal plates with for the most part as many as fourteen to eighteen small, slender setæ, the sternal plates with twelve to fourteen.

MALE (Fig. 138). Length .8 mm. *Head* broader and more nearly truncate anteriorly than in the female; antennæ with the first segment much enlarged and with the third segment strongly modified.

Tergal and sternal plates of the abdomen arranged in the typical

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manner, the tergal plates occupying the greater part of the width of the body and bearing as many as sixteen or seventeen small setæ, the sternal plates occupying about the median half of the body and with for the most part eight or nine small setæ.

Genitalia (Fig. 139*C*) with the basal plate moderately slender, the parameres (*par*) about half as long as the basal plate, tapering, sub-

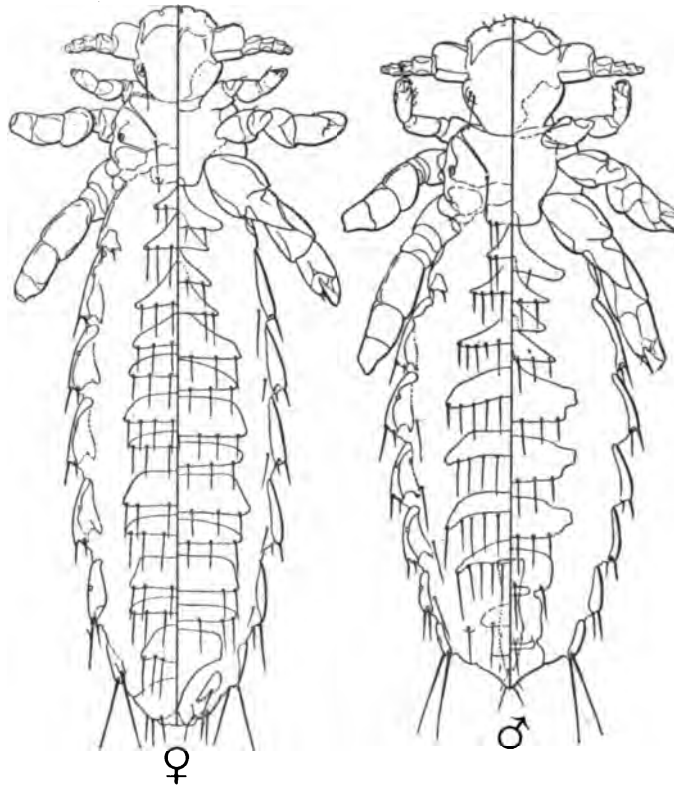

Fig. 140.—*Polyplax auricularis* Kellogg and Ferris, male and female, from the types.

parallel and enclosing the short, wedge-shaped pseudopenis (*pp*) and the small statumen penis (*sp*).

Notes.—This is a member of the *P. otomydis* group, distinguished chiefly by the form of the head, the chætotaxy and form of the pleural plates and the modified antennæ of the male.

16. **Polyplax auricularis** Kellogg and Ferris.

Figs. 140, 141.

1915. *Polyplax auricularis* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.*, p. 13–15; tf. 2; pl. 1, f. 4; pl. 4, f. 8.

1916. *Polyplax auricularis* K. and F., Ferris, *Psyche* 23: 99.

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1916. *Polyplax auricularis* K. and F., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 172.

PREVIOUS RECORDS. Types from *Peromyscus maniculatus rubidus,* Inverness, Marin County, California. Also from *Peromyscus sitchensis prevostensis,* Forrester Island, Alaska; *Peromyscus maniculatus gambeli,* Yosemite National Park, California; *Onychomys torridus pulcher,* Victorville, California; *O. leucogaster arcticeps,* Colorado Springs, Colorado.

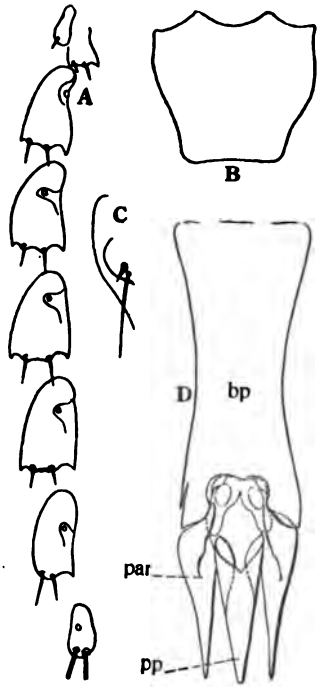

Fig. 141.—*Polyplax auricularis* Kellogg and Ferris: *A,* pleural plates of female; *B,* sternal plate; *C,* lateral margin of hind head; *D,* genitalia of male; from the types.

SPECIMENS EXAMINED. All those upon which the above records are based and the following: *Peromyscus* sp., Woodward, Oklahoma; *Reithrodontomys mexicanus,* Tohontepec, Chiapas, Mexico, (U. S. N. M. 68685) and *Neotomodon allstoni,* near Mexico City, Mexico (U. S. N. M. 50656).

FEMALE. (Fig. 140). Length 1.5 mm. *Head* as broad as long, broadly rounded in front of the antennæ, which are set close to the anterior margin; with the post-antennal angles prominent and rounded, the posterior lateral angles represented by a small, ear-like flap which is set

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somewhat in from the lateral margin (Fig. 141*C*) and from which arise the usual setæ, the lateral margins of the hind head roundly convex and strongly convergent; antennæ with the first segment much enlarged. *Thorax* scarcely longer than the head, the lateral margins convex; sternal plate (Fig. 141*B*) very broad, ill defined; middle and posterior legs nearly of equal size except for the coxæ of the hind legs which are much enlarged.

Pleural plates (Fig. 141*A*) as follows: first pair divided, the dorsal lobe broader than the ventral and bearing two small setæ, the ventral with but one; plates of the third to sixth segments each with a slight tooth at each posterior angle and with a pair of small setæ; plates of the seventh segment with a tooth at the dorsal angle only and with two small setæ; plates of the eighth segment small, with the usual long setæ.

Tergal and sternal plates of the abdomen well developed, occupying about the median half of the body, for the most part with six small setæ.

MALE (Fig. 140). Length 1.1 mm. *Head* as in the female except the third antennal segment modified.

Tergal and sternal plates of the abdomen arranged in the typical manner, large, occupying the median half of the body, the tergal plates with for the most part eight to ten small setæ, the sternal with four to six.

Genitalia (Fig. 141*D*) with the basal plate quite broad, the parameres (*par*) tapering, parallel, enclosing the wedge-shaped pseudopenis (*pp*).

NOTES.—This species in the form of the genitalia of the male is a member of the *otomydis* group but it is easily recognizable from the peculiar form of the head and the sternal plate alone.

17. **Polyplax brachyrrhynchus** Cummings.

FIGS. 142, 143.

1915. *Polyplax brachyrrhynchus* Cummings, *Proc. Zool. Soc. London*, p. 246–251, 265–8; tf. 1–3, 13–14.

1916. *Polyplax brachyrrhynchus* Cumm., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 172.

PREVIOUS RECORDS. From *Acomys cahirinus*, Assiut, Egypt.

SPECIMENS EXAMINED. From *Acomys hystrella*, Nimule, Uganda (U. S. N. M. 165216) and *Acomys percivali*, Marsabit Road, British East Africa (U. S. N. M. 182953).

FEMALE (Fig. 142). A very slender species. Length 1.4 mm. *Head* somewhat longer than broad, truncate in front of the antennæ which are set close to the anterior margin; with slight post-antennal angles and with a distinctly constricted occipital region, the lateral margins of the hind head sub-parallel; antennæ with the first segment not greatly enlarged. *Thorax* about as long as the head and scarcely wider, the lateral margins

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nearly straight and parallel; sternal plate obsolete, the coxæ of all the pairs of legs almost contiguous; middle legs but little larger than the anterior; posterior legs relatively very large and stout.

Pleural plates as follows: each except the first with a pair of long

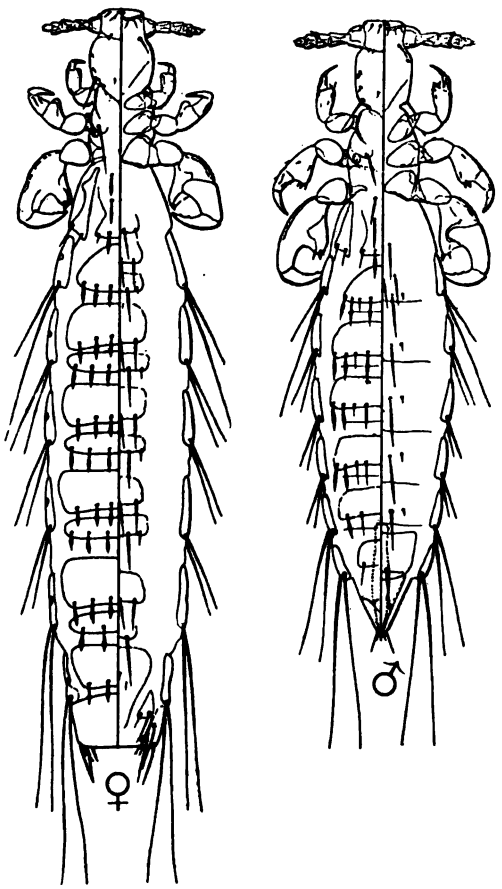

Fig. 142.—*Polyplax brachyrrhynchus* Cumm., male and female, from specimens from *Acomys hystrella*.

setæ; first pair not divided longitudinally; plates of the third to eighth segments quite small, without a tooth at the posterior angles.

Tergal plates strongly developed, occupying the greater part of the width of the abdomen, the anterior plate of each pair the larger, for the most part with six short but stout, clavate setæ (Fig. 143*B*). *Sternal plates* very weakly developed and confined to less than the median half of the abdomen, with from two to four slender setæ.

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MALE (Fig. 142). Length 1.1 mm. *Head* as in the female, except the third segment of the antennæ slightly modified.

Tergal plates strongly developed and large, with for the most part eight setæ of which part are slender and part are stout and clavate as in the female. *Sternal plates* lacking, the rows of setæ departing from the typical arrangement in that there are two rows on the third segment only; rows of setæ consisting for the most part of a median pair of long and an outer pair of very small setæ.

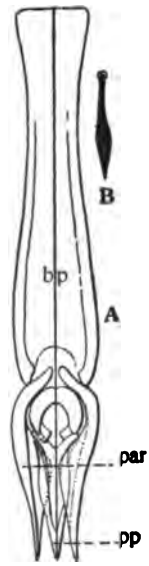

Fig. 143.—*Polyplax brachyrrhynchus* Cumm.: *A*, genitalia of male; *B*, seta from abdomen; from specimens from *Acomys hystrella*.

Genitalia (Fig. 143*A*.) with the basal plate (*bp*) long and slender; parameres (*par*) slightly less than half as long as the basal plate, tapering, sub-parallel, enclosing the rather long, wedge-shaped pseudopenis (*pp*) and a ring-shaped piece which is perhaps the statumen penis (*sp*).

NOTES.—This is, in the character of the male genitalia, a member of the *P. otomydis* group but it is a very distinctive species, recognizable at once by the attenuated form, the peculiarly shaped setæ of the abdominal tergites and the entire absence of a sternal plate on the thorax. It seems to occur normally in company with *P. oxyrrhynchus* and these two species form one of the very few cases in which two species of the same genus occur normally together on the same host.

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18. Polyplax phthisica n. sp.

FIGS. 144, 145.

SPECIMENS EXAMINED. Holotype, a female, and allotype from *Lophuromys aquilus,* Ngani Narok River, British East Africa (U. S. N. M. 162548). Also from *L. zena,* Molo, British East Africa (F. C. M. 16866); *L. sikapusi pyrrhus,* Rhino Camp, Uganda (U. S. N. M. 165210),

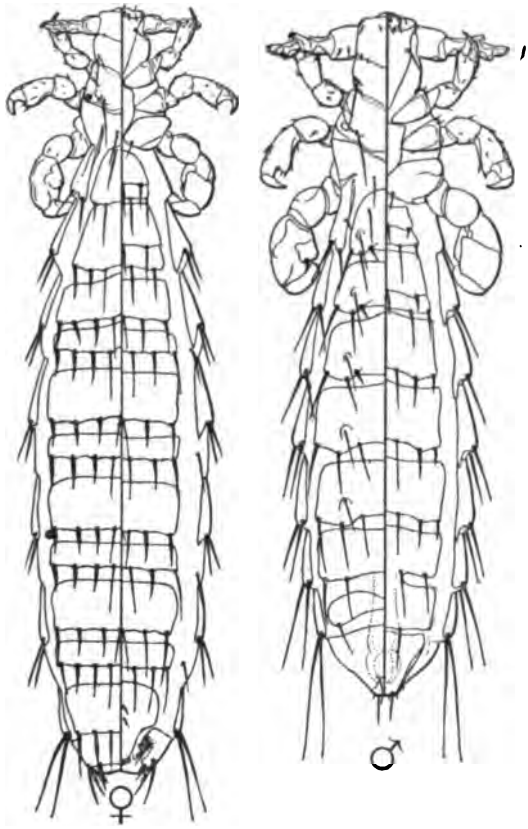

Fig. 144.—*Polyplax phthisica* n. sp., male and female, from the types.

and *Lophuromys* sp., Mlanje Plateau, Nyasaland (British Museum). A single specimen from *Thamnomys ibeanus,* British East Africa (F. C. M. 17097) is possibly a straggler.

FEMALE (Fig. 144). A very slender species. Length 1.5 mm. *Head* relatively very small, about as broad as long, truncate in front of the antennæ, which are set close to the anterior margin; with very slight post-antennal angles and a distinctly constricted occipital region, the lateral margins of the hind head almost parallel; antennæ with the basal

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segment but little enlarged. *Thorax* slightly less than twice as long as the head and but little wider, the lateral margins slightly convex; sternal plate (Fig. 145*B*) shield-shaped; middle legs somewhat larger than the anterior, the posterior legs short and stout.

Pleural plates (Fig. 145*A*) as follows: each with a pair of setæ which are as long as the plate itself; plates of the first segment not divided longitudinally; plates of the third to sixth segments very slender, with the

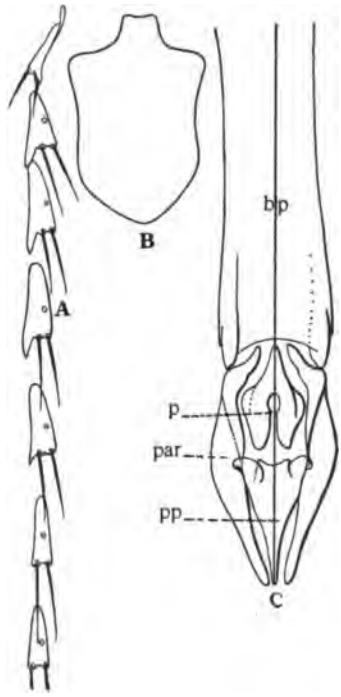

Fig. 145.—*Polyplax phthisica* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male; from the types.

ventral angle produced into a short tooth; plates of the seventh and eighth segments smaller, without teeth.

Tergal and sternal plates of the abdomen occupying the greater part of the width of the body, the anterior plate of each pair much larger than the posterior. Tergal plates with for the most part seven to eight setæ of which part are stout but sharply pointed; the others slender; sternal plates with for the most part five or six setæ, similar to those on the dorsum. Posterior margin of the plates slightly emarginate between the setæ.

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MALE (Fig. 144). Length 1 mm. *Head* as in the female except the first segment of the antennæ much enlarged and the third strongly modified.

Tergal and sternal plates of the abdomen arranged in the typical manner, strongly developed, occupying the greater part of the surface. Tergal plates with the median half of the posterior margin slightly emarginate, the lateral prominences bearing three quite stout setæ. Cephalad of these setæ, on the second to sixth segments, is a single small seta well removed from the posterior margin. Sternal plates likewise slightly emarginate medially but with the setæ evenly spaced, with for the most part four to six in each row.

Genitalia (Fig. 145*C*) with the basal plate (*bp*) moderately stout; parameres (*par*) more than half as long as the basal plate, tapering, subparallel, enclosing the acute, wedge-shaped pseudopenis (*pp*) and a ring-shaped statumen penis (*sp*).

NOTES.—In its slender form this species approaches *P. brachyrrhynchus* but the shape of the sternal plate and pleural plates and the form of the tergal plates of the male are very distinctive.

19. **Polyplax oxyrrhynchus** Cummings.

FIGS. 146, 147.

1915. *Polyplax oxyrrhynchus* Cummings, *Proc. Zool. Soc. London*, p. 251–65; tf. 4–6, 8, 9, 11–13.

1916. *Polyplax oxyrrhynchus* Cumm., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 174.

PREVIOUS RECORDS. From *Acomys cahirinus*, Assiut, Egypt.

SPECIMENS EXAMINED. A male and a female from *Acomys hystrella*, Nimule, Uganda (U. S. N. M. 165216) and a single female from *A. percivali*, Marsabit Road, British East Africa (U. S. N. M. 182953).

FEMALE (Fig. 146). General form quite slender. Length 1.5 mm. *Head* about twice as long as wide, acutely pointed in front of the antennæ which are set well back from the apex; with very slight post-antennal angles and without a constricted occipital region, the lateral margins of the hind head nearly straight and slightly convergent; antennæ with the first segment not greatly enlarged. *Thorax* very small, scarcely more than half as long as the head and but little wider, with the lateral margins angularly convex; sternal plate (Fig. 147*B*) shield-shaped; legs of ordinary form, the middle pair but little larger than the anterior, the posterior pair very large and stout.

Pleural plates (Fig. 147*A*) as follows: each with a pair of setæ as long or longer than the plate itself; plates of the second segment distinctly divided longitudinally, the parts very small; plates of the third to sixth

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segments slender, elongate, each with a short tooth at the ventral posterior angle; plates of the seventh and eighth segments without teeth.

Tergal and sternal plates of the abdomen strongly developed, occupying about three-fourths of the width of the body, the anterior plate of

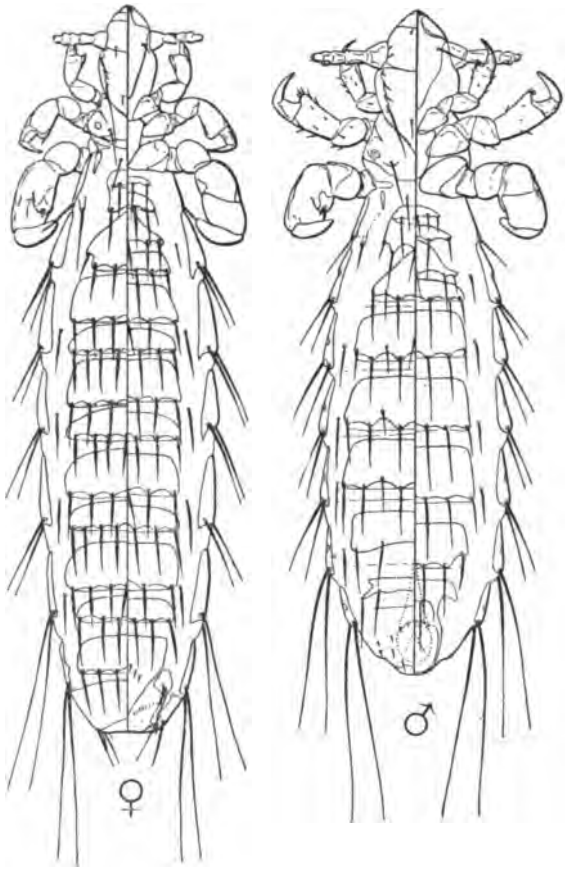

Fig. 146.—*Polyplax oxyrrhynchus* Cumm., male and female, from specimens from *Acomys hystrella*.

each pair about twice as long as the posterior, the plates with for the most part six to eight quite large setæ. Posterior margin of the plates emarginate between the setæ.

MALE (Fig. 146). Length 1 mm. *Head* as in the female, the antennæ not modified.

Tergal and sternal plates of the abdomen arranged in the typical manner, strongly developed, with for the most part six to eight setæ. Plates emarginate between the setæ.

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Genitalia (Fig. 147*C*) with the basal plate (*bp*) strongly expanded posteriorly; parameres (*par*) laterally compressed and strongly curved, forming almost a circle, enclosing the Y-shaped pseudopenis (*pp*) and the penis (*p*).

NOTES.—This is to be regarded as a member of the *P. otomydis* group. The character of the pleural plates and the peculiar genitalia of the males are distinctive characters. It appears to occur normally in company with *P. brachyrrhynchus*, as has been pointed out in connection with the latter.

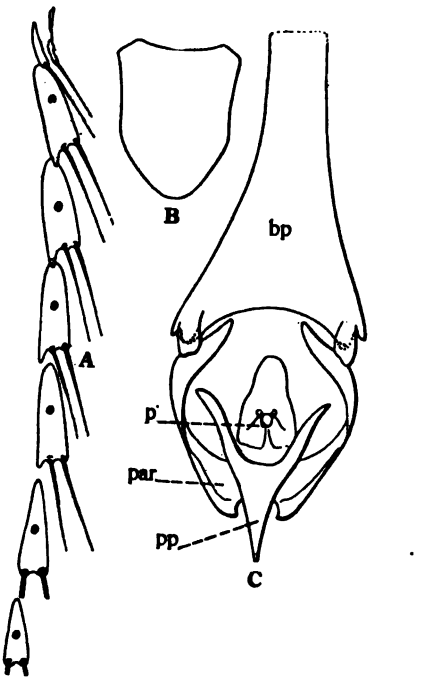

Fig. 147.—*Polyplax oxyrrhynchus* Cumm.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male.

20. Polyplax arvicanthis Bedford.

FIGS. 148, 149.

1919. *Polyplax arvicathus* Bedford, *Rept. Div. Vet. Res., Dept. Agric., Un. S. Africa* **5–6**: 716–7; pl. 1, f. 3, 6. (Captions of figures labeled *P. arvicanthus*.)

PREVIOUS RECORDS. From *Arvicanthis* (= *Arvicanthus*) *pumilio*, Onderstepoort, Pretoria, South Africa.

SPECIMENS EXAMINED. From *Arvicanthis pumilio diminutis*, Mt. Kenya, British East Africa (U. S. N. M. 164194) and from the type host and locality, the latter received through the kindness of Mr. Bedford.

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FEMALE (Fig. 148). Length 1.2 mm. *Head* as broad as long, narrowly truncate anteriorly, with the antennæ set close to the apex, with rounded post-antennal angles, the lateral margins of the hind head slightly convergent, the posterior lateral angles represented by small processes

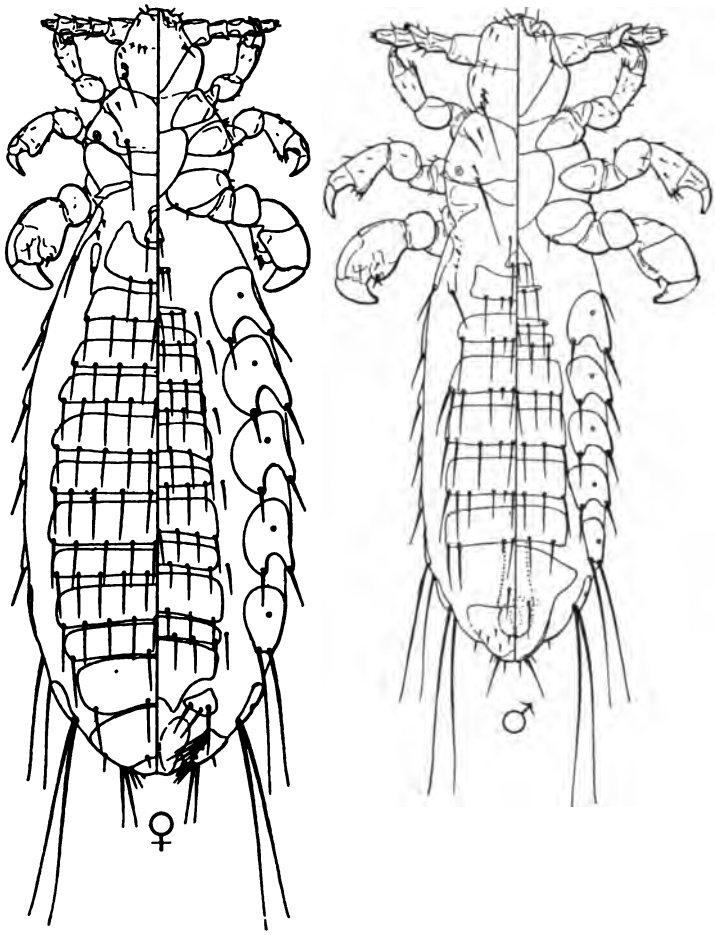

Fig. 148.—*Polyplax arvicanthis* Bedford, male and female, from specimens from *Arvicanthis pumilio*, Anderstepoort, South Africa.

slightly removed from the margin; antennæ with the basal segment not greatly enlarged. *Thorax* much longer and broader than the head, the lateral margins strongly convex; sternal plate as in Fig. 149*B*; anterior and middle legs nearly of the same size, the posterior legs large and stout.

Pleural plates of an unusual form; plates of the second segment

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divided into two small lobes, each bearing a short seta; plates of the third to sixth segments large, the dorsal margin nearly straight, the ventral margin almost semi-circular, the posterior margin with a deep emargination, each of the points formed by this emargination bearing a short seta; plates of the seventh and eighth segments smaller, without the posterior emargination and with the usual long setæ.

Tergal and sternal plates strongly developed, the former occupying nearly the entire width of the abdomen, the latter the median half. Tergal

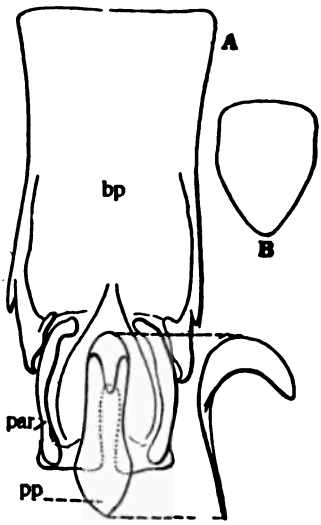

Fig. 149.—*Polyplax arvicanthis* Bedford: *A*, genitalia of male; *B*, sternal plate; from specimens from *Arvicanthis pumilio*, Anderstepoort, South Africa.

plates with for the most part eight to ten small setæ, the sternal plates with six or seven.

MALE (Fig. 148). Length .6 mm. *Head* broader than in the female, the basal segment of the antennæ enlarged, the third segment modified.

Tergal and sternal plates of the abdomen arranged in the typical manner, large, occupying the greater part of the surface of the abdomen. Tergal plates with for the most part ten to twelve setæ of variable lengths, the sternal plates with six or seven.

Genitalia (Fig. 149*A*) with the basal plate very broad, the posterior angles produced; parameres (*par*) short, nearly parallel and flattened at the apex so fused with the endomeral pieces as to be difficult to distinguish; pseudopenis (*pp*) enclosed between the parameres, the base bent upward in the form of a strong hook as in the species of the *spinulosa* group.

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NOTES.—The very peculiar pleural plates and genitalia of the male separate this species widely from all the others of the genus except the next, which, in the female at least is somewhat of the same type.

The proper spelling of the name of this species is doubtful owing to typographical errors in the original description. I have adopted the spelling *arvicanthis*.

21. Polyplax abyssinica n. sp.

FIG. 150.

MATERIAL EXAMINED. Females only; one, the holotype, from *Arvicanthis abyssinicus nubilans*, Bugondo Teso, Uganda; two from the same host, S. Bugishu, Bubulu, Uganda; one from *Otomys tropicalis elgonis* and

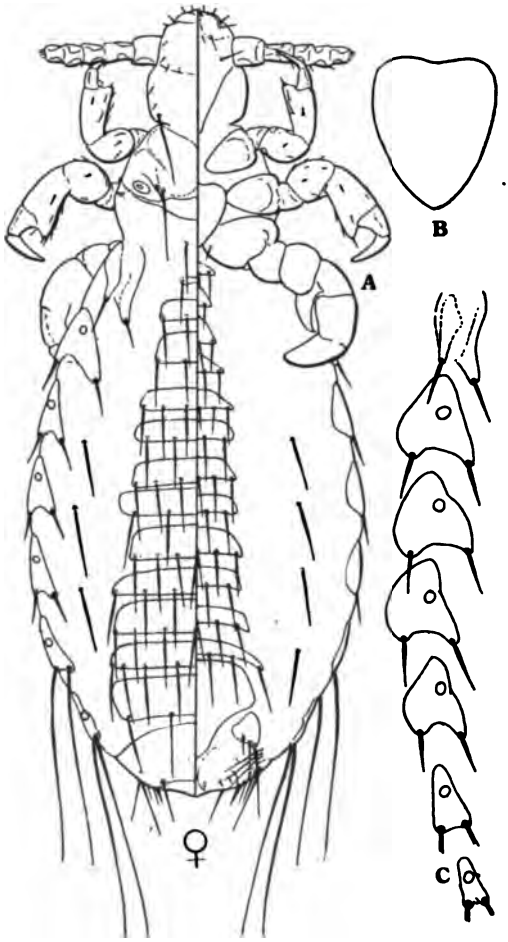

Fig. 150.—*Polyplax abyssinica* n. sp.: *A*, female; *B*, sternal plate; *C*, pleural plates; from the holotype.

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one from *Œnomys bacchante,* N. Bugishu, Sipi, Uganda. All these are included in material received as a loan from the British Museum and are deposited in the collections of that institution.

FEMALE (Fig. 150*A*). Length 1.2 mm. *Head* slightly longer than wide, slightly produced in front of the antennæ; with very slight post-antennal angles but with a distinctly constricted occipital region, the lateral margins of the hind head very slightly convex and nearly parallel. *Thorax* about as long as the head, the lateral margins rather roundly convex; sternal plate (Fig. 150*B*) cordate.

Pleural plates (Fig. 150*C*) as follows: plates of the second segment very distinctly divided into two lobes, each of which bears a short seta; plates of the third to sixth segments triangular in form with the posterior margin slightly emarginate, the dorsal margin nearly straight and the ventral margin somewhat convex, each posterior angle with a short seta; plates of the seventh and eighth segments small, more or less triangular, with the usual long setæ; spiracles noticeably large.

Tergal and sternal plates of the abdomen well developed but small, the tergal plates occupying scarcely the median half of the abdomen and bearing for the most part six or seven slender setæ, the sternal plates occupying a third or less of the width of the abdomen and bearing for the most part four or five slender setæ.

NOTES.—This species is evidently quite close to *P. arvicanthis* but is easily separable by the much smaller tergal and sternal plates and the smaller and less deeply emarginate pleural plates.

22. **Polyplax insulsa** n. sp.

FIGS. 151, 152*A-C*.

SPECIMENS EXAMINED. From *Epimys sabanus,* Bunguran, Natuna Islands (U. S. N. M. 104765). Holotype a female.

FEMALE (Fig. 151). Length 1.05 mm. *Head* relatively large, acute anteriorly, with the antennæ set somewhat back from the apex; post-antennal angles slight, rounded; without a constricted occipital region, the lateral margins of the hind head nearly straight, very slightly convergent; antennæ with the first segment not greatly enlarged. *Thorax* shorter than the head, with the lateral margins strongly angulate; sternal plate (Fig. 152*B*) very small, almost quadrate; middle legs nearly as large as the posterior but with more slender claw, posterior legs very stout, the outer proximal angle of the tarsus with a small tooth-like projection.

Pleural plates (Fig. 152*A*) as follows: plates of second segment divided into two small pieces, the ventral with a short seta, the dorsal with a very long seta; plates of the third to sixth segments triangular with a small dorsal tooth and a longer ventral process; plates of the third segment

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with the dorsal seta very long, the ventral short, the others with the setæ nearly equal and short; plates of the seventh segment with but a slight dorsal tooth and with a pair of long setæ; plates of the eighth segment small, with the usual long setæ.

Tergal plates very slender and occupying but the median half of the

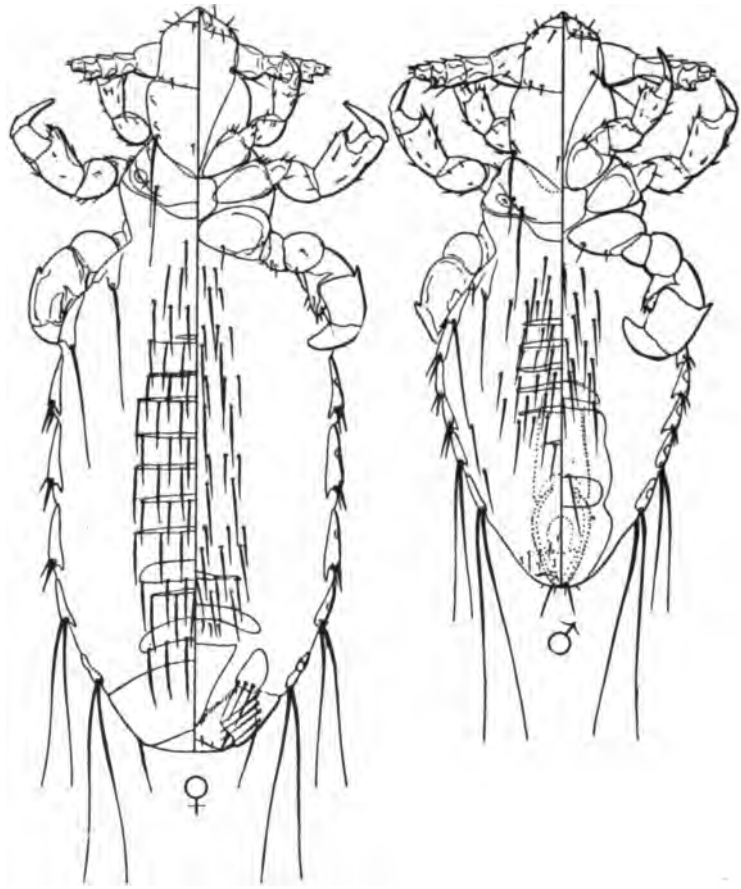

Fig. 151.—*Polyplax insulsa* n. sp., male and female.

abdomen, with for the most part six rather large setæ. *Sternal plates* undeveloped, except for the seventh segment and the genital plate; rows of setæ confined to less than the median half of the abdomen, each with four to six setæ.

MALE (Fig. 151). Length .6 mm. *Head* as in the female, the antennæ not modified.

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Tergal plates of the abdomen slender and occupying not more than the median half, the rows of setæ with for the most part six or seven. *Sternal plates* undeveloped except for the very large genital plate, which extends forward nearly to the middle of the abdomen, and the plate of the seventh segment; rows of setæ containing but four setæ, apparently departing from the typical arrangement in that there are two rows on not more than one of the segments (second or third probably).

Genitalia (Fig. 152*C*) with the basal plate very broad, the parameres (*par*) more than half as long as the basal plate, curved and somewhat

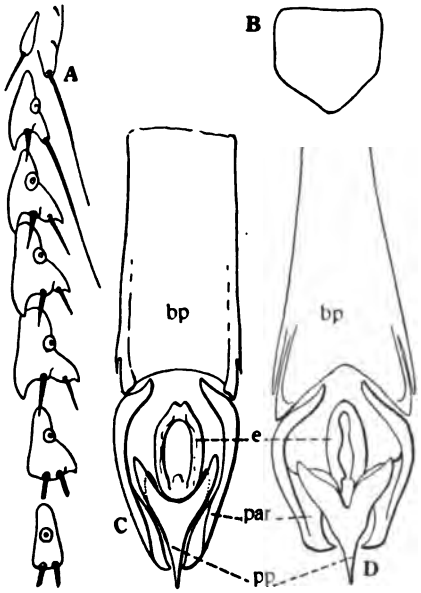

Fig. 152.—*Polyplax insulsa* n. sp.: *A*, pleural plates of female; *B*, sternal plate; *C*, genitalia of male. *Polyplax asiatica* n. sp.: *D*, genitalia of male.

flattened at the tips, enclosing the Y-shaped pseudopenis and a ring-shaped endomeral piece (*e*) which surrounds the penis (*p*).

Notes.—This species is possibly a member of the *otomydis* group. The small sternal plate of the thorax, the character of the pleural plates, the absence of sternal plates on the abdomen and the character of the genitalia of the male are distinctive. Its nearest relative is the next species.

23. **Polyplax asiatica** n. sp.

Fig. 152*D*.

Specimens Examined. Holotype, a female, and allotype from *Crocidura cærulea*, a shrew, Rangoon, Burma (Nuttall). Several females from

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a murine rodent, *Nesokia harwickii,* Quetta, Beluchistan (U. S. N. M. 200314) appear to be the same species and it is possible that the normal hosts are rodents.

FEMALE. Practically identical with the female of *P. insulsa* except for the absence of the tergal and sternal plates on the abdomen, the genital plate alone being developed. Size somewhat larger, length 1.3 mm.

MALE. Practically as in the male of *P. insulsa* except that the genital plate is much smaller and the details of the genitalia are slightly different (Fig. 152*D*). Length .9 mm.

NOTES.—It is possible that this should not be recognized as distinct from *P. insulsa,* at least as anything more than a subspecies. However, the material is scanty and nothing is known as to the possible range of variation and as the two forms are recognizably different they may for the present be separated.

24. **Polyplax gracilis** Fahrenholz.

1910. *Polyplax gracilis* Fahrenholz, *Zool. Anz.* **35**: 317.
1912. *Polyplax gracilis* Fahr., Fahrenholz, *Jahresb. d. Niedersäch. Zool. Ver.* **2–4**: 42; tf. 16–17; pl. 1, f. 10–11.
1916. *Polyplax gracilis* Fahr., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 173 (part).

PREVIOUS RECORDS. From *Micromys* (= *Mus*) *minutus,* Europe.

NOTES.—I have not seen specimens of this species. As far as may be judged from the original description and figures of Fahrenholz it is a member of the *spinulosa* group, although the genitalia of the male were not described. According to Fahrenholz it differs from *spinulosa* in having the post-antennal and post-lateral angles of the head more rounded, the head thus appearing more slender and in the chætotaxy of the abdomen, the pleural plates being the same.

According to the description: "Die übrigen Borsten des Abdomens sind wesentlich schwächer als bei *Polyplax affinis,* nur das mittlere Paar der einzelnen Segmente auf der Dorsalseite des ♂ sind verhältnis mäszig kräftig gebaut; dieselben Borstenpaare des fünften, sechsten und siebten Segments bieten auszerdem noch ein besonderes Artmerkmal, da sie dem vorderen Segmentrande viel näher stehen als der stets am Hinterrande inserierten Querreihe der übrigen Borsten ihres Segments."

I have previously erroneously identified as this species, specimens from South Africa that I now refer to *Polyplax cummingsi* Ferris.

25. **Polyplax calva** Waterston.

FIGS. 153, 154.

1917. *Polyplax calva* Waterston, *Parasitology* **9**: 199–212; figs.

PREVIOUS RECORDS. Types from *Cricetomys gambianus,* Accra. Also from *Cricetomys* sp., Zanzibar. The host is a murine rodent.

SPECIMENS EXAMINED. From *Cricetomys gambianus,* Accra (received through the kindness of Miss A. M. Evans); *C. gambianus osgoodi,* Mazeras, British East Africa (U. S. N. M. 181806); *C. gambianus enguvi,*

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Taita Mts., British East Africa (U. S. N. M. 183125); *Cricetomys* sp., Voi, British East Africa (F. C. M. 17043).

FEMALE (Fig. 153). Length 1.9 mm. *Head* at least twice as long as broad, acutely rounded anteriorly, the antennæ set well back from the apex; with no post-antennal angles, the hind head merely somewhat swollen, but with a distinctly constricted occipital region; antennæ slender,

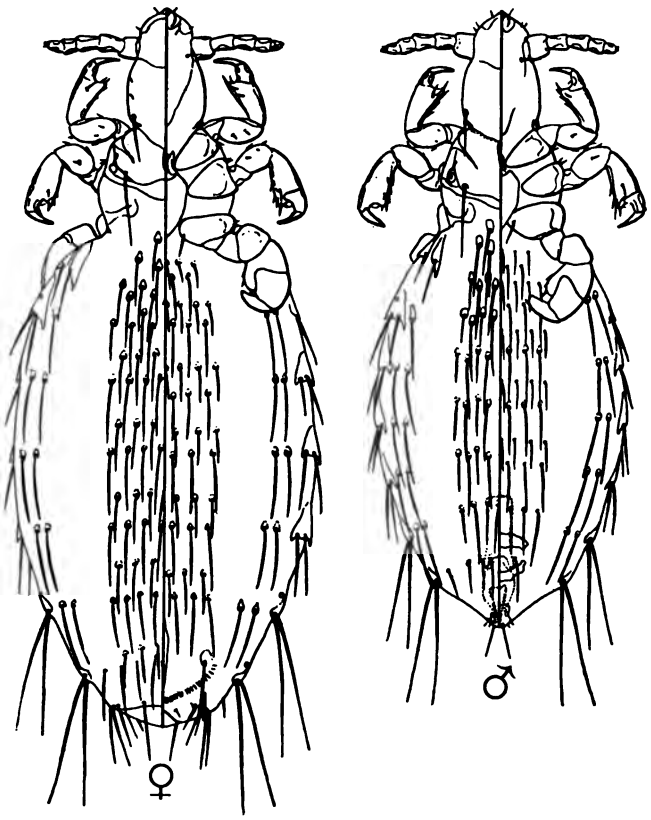

Fig. 153.—*Polyplax calva* Waterston, male and female, from specimens from *Cricetomys gambianus*, Accra.

the basal segment not enlarged. *Thorax* about as long as the head, with the lateral margins convex; sternal plate (Fig. 154*B*) with a handle-like anterior piece composed of two longitudinally separated parts; anterior and middle legs quite large, but slender, posterior legs stout.

Pleural plates (Fig. 154*A*) relatively very small, all, except on the second segment, nearly quadrate in shape, with the posterior angles slightly produced and with a pair of long stout setæ on the posterior margin,

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except on the seventh and eighth segments where the usual slender setæ are present; plates of the second segment divided longitudinally into a small ventral piece and an elongate dorsal piece.

Tergal and sternal plates of the abdomen entirely lacking. Setæ arranged in three series, a median group of for the most part six or eight and on the third to eighth segments a lateral group of one or two close to the margin on each side. All the setæ are quite long.

MALE (Fig. 153). Length 1.5 mm. *Head* as in the female, the antennæ not at all modified.

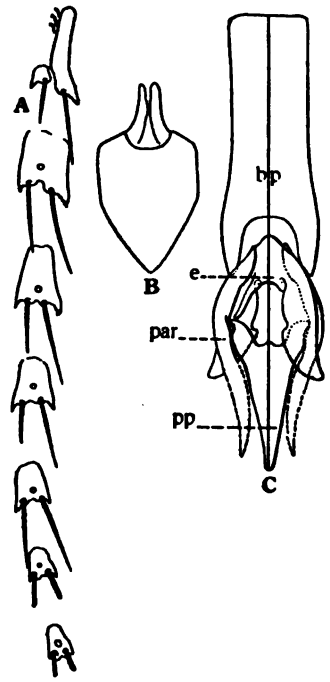

Fig. 154.—*Polyplax calva* Waterston: *A*, pleural plates; *B*, sternal plate; *C*, genitalia of male; from specimens from *Cricetomys gambianus*, Accra.

Tergal and sternal plates of the abdomen entirely lacking except for the very small genital plates. Setæ distributed in three series as in the female, the arrangement of the rows departing from that typical in *Polyplax* in that there are two rows on the second to sixth sternites.

Genitalia (Fig. 154*C*) with the basal plate (*bp*) rather short, the posterior angles produced; parameres (*par*) more than half as long as the basal plate curved, enclosing the stout wedge-shaped pseudopenis. At the base of the parameres is a piece in the form of an inverted V which possibly represents the endomeres.

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NOTES.—This species departs so far from typical *Polyplax* that its inclusion in the genus is perhaps open to question and certainly complicates the generic diagnosis. However, it may remain here for the present.

26. Polyplax miacantha Speiser.

1905. *Polyplax miacantha* Speiser, *Centralbl. f. Bakter., Originale,* **38**: 318–9. (The figure does not belong with this.)
1908. *Polyplax miacantha* Speiser, Dalla Torre, "Anoplura," *Gen. Ins.* p. 13.
1916. *Polyplax miacantha* Speiser, Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 173.

PREVIOUS RECORDS. Recorded as found "auf einer kleinen Ratte mit sehr dicken stachelartigen Haaren in der Sammlung des Zoologischen Museums zu Königsberg i. Pr., die nebst 2 anderen Mus-Arten in demselben Glase als aus Salomona in Abessinien stammend bezeichnet war. . . ." Described from the female alone.

NOTES.—The original description of this species is entirely inadequate and will not permit a decision even as to the generic position.

The only important points in this description may be summarized as follows: length 1.5-1.75 mm.; head as long as broad, produced in front of the antennæ so that the latter stand about two-fifths of the length of the head back from the apex; thorax smaller anteriorly than the hind head, becoming somewhat broader posteriorly, longer than broad posteriorly, dorsally without setæ; sternal plate shield-shaped; anterior legs small, with slender claw, middle legs longer and with strong, rather thick claw, posterior legs very short, heavy and compressed; abdomen with but one thorn-like seta on the lateral margin of the fourth to seventh segments.

The species is likely to remain unrecognizable until the types have been examined.

Genus **NEOHÆMATOPINUS** Mjöberg.

1910. *Neohæmatopinus,* Mjöberg, *Arkiv f. Zool.* **6**, 13: 160.
1910. *Acanthopinus,* Mjöberg, *ibid.* **6**, 13: 160.
1912. *Neohæmatopinus,* Cummings, *Bull. Ent. Res.* **3**: 393.
1914. *Linognathoides,* Cummings, *ibid.* **5**: 159.
1915. *Linognathoides,* Kellogg and Ferris, "Anoplura and Mall. North Amer. Mamm.," *Stanford Univ. Publ.* p. 23.
1915. *Neohæmatopinus,* Kellogg and Ferris, *ibid.* p. 35.
1915. *Lutegus,* Fahrenholz, *Archiv f. Naturges.* **81**, 11: 31.
1916. *Linognathoides,* Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 158.
1916. *Neohæmatopinus,* Ferris, *ibid.* p. 168.

Anoplura without eyes; with five-segmented antennæ which are usually sexually dimorphic, the third segment in the male having the distal preaxial angle more or less produced and bearing one or two stout, recurved setæ, some species having the first segment in both sexes with the distal, post-axial angle bearing a very stout seta or with such a seta near the posterior margin of this segment; with the anterior legs small and weak, the middle and posterior legs much larger, sub-equal and with stout claw; pleural plates always present on the second to eighth segments and at

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times in vestigial form on the first segment, the plates of the second segment showing no traces of a longitudinal division; female with two (exceptionally three) rows of setæ on the second to seventh tergites and the second to sixth sternites of the abdomen, these either accompanied wholly or in part by, or entirely without, chitinized plates; male always with two rows of setæ on the second tergite and the second to sixth sternites of the abdomen, exceptionally with two rows on the second to sixth tergites, the second plate of the second tergite always more or less emarginate posteriorly; sternal plates of third abdominal segment never, and of the second rarely, extending from pleurite to pleurite; head usually with strong post-antennal angles and a distinctly constricted occipital region; genitalia of the males of no constantly distinctive type.

HOSTS. Occurring characteristically on rodents of the family *Sciuridæ*, the squirrels, ground squirrels, marmots and the like, and the family *Petauristidæ*, the flying squirrels. Two species occur on rodents of the family *Muridæ*, the particular species infested being of the so-called "wood rats" or "pack rats" of western United States and Mexico.

TYPE OF THE GENUS. *Hæmatopinus sciuropteri* Osborn.

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS.

NOTE.—Names in italics are synonyms of the names with which they are coupled. The genera *Acanthopinus*, *Linognathoides* and *Lutegus* are considered as synonyms of Neohæmatopinus and names used in these genera are included as if used in *Neohæmatopinus*.

antennatus (Osborn).
Neohæmatopinus sciurinus (Mjöberg).

antennatus var. *semifasciatus* Ferris.
Neohæmatopinus sciurinus (Mjöberg).

citelli (Cummings).
Linognathoides citelli Cummings.
Linognathoides spermophili Cummings (not of Grube).

columbianus (Osborn).
Neohæmatopinus læviusculus (Grube).

faurei (Bedford).
Linognathoides faurei Bedford. (Generic position doubtful; to be considered later.)

echinatus (Neumann).
Hæmatopinus (*Polyplax*) *echinatus* Neumann.

heliosciuri Cummings.

inornatus (Kellogg and Ferris).
Linognathoides inornatus Kellogg and Ferris (part).

inornatus (Kellogg and Ferris) (part; misidentification).
Neohæmatopinus sciurinus (Mjöberg).

læviusculus (Grube).
Pediculus læviusculus Grube.
Pediculus spermophili Grube.

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Hæmatopinus læviusculus (Grube).
Polyplax læviuscula (Grube).
Linognathoides læviusculus (Grube).
Hæmatopinus montanus Osborn.
Polyplax montana (Osborn).
Linognathoides montanus (Osborn).
Hæmatopinus columbianus Osborn.
Polyplax columbiana (Osborn).
Enderleinellus læviusculus (Grube).

macrospinosus Fahrenholz.
Neohæmatopinus sciurinus (Mjöberg).

montanus (Osborn).
Neohæmatopinus læviusculus (Grube).

pacificus Kellogg and Ferris.

pectinifer (Neumann).
Hæmatopinus setosus Piaget (not of Burmeister).
Linognathoides setosus (Piaget).
Hæmatopinus (*Polyplax*) *pectinifer* Neumann.
Linognathoides pectinifer (Neumann).
Lutegus pectinifer (Neumann).

sciurinus (Mjöberg).
Acanthopinus sciurinus Mjöberg.
Hæmatopinus antennatus Osborn (not of Piaget).
Polyplax (?) *antennata* (Osborn).
Acanthopinus antennatus (Osborn).
Neohæmatopinus antennatus (Osborn).
Neohæmatopinus macrospinosus Fahrenholz.
Neohæmatopinus antennatus var. semifasciatus Ferris.
Linognathoides inornatus Kellogg and Ferris (part; misidentification).

sciuropteri (Osborn).
Hæmatopinus sciuropteri Osborn.
Polyplax (?) *sciuropteri* (Osborn).

setosus (Piaget) (not of Burmeister).
Neohæmatopinus pectinifer (Neumann).

NOTES.—At first glance this genus, as I here interpret it, seems to form a rather heterogeneous group. The strongly modified first antennal segment of such species as *N. sciurinus* would seem to separate these species quite sharply from the others in which this character does not appear and to form an excellent generic character. It is in fact upon this that the genus *Acanthopinus* was originally based. But it is evident from the rather large amount of material that is available to me that this character is of no real importance for some specimens in which this peculiar modification appears scareely or not at all are not separable in any other way from specimens in which it is strongly developed. In fact it is questionable in some cases that it is even of specific value.

With this character removed from consideration there remains nothing of significance by which the genus can be divided and there are several characters by which the included species are quite closely bound together. The only really disturbing species are *N. petauristæ* n. sp. and *N. batuanæ* n. sp. which seem really to belong here but which require a considerable stretching of the generic definition in order to permit

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their inclusion. These two species might perhaps stand as one subgeneric group, with another for *N. citelli, lævisculus, marmotæ* and *pectinifer* and another for the typical forms, but I see no necessity for subgenera at present.

N. pectinifer has been made the type of the genus *Lutegus* but this appears to be strictly congeneric with *Linognathoides,* even were the latter to be separated from *Neohæmatopinus.*

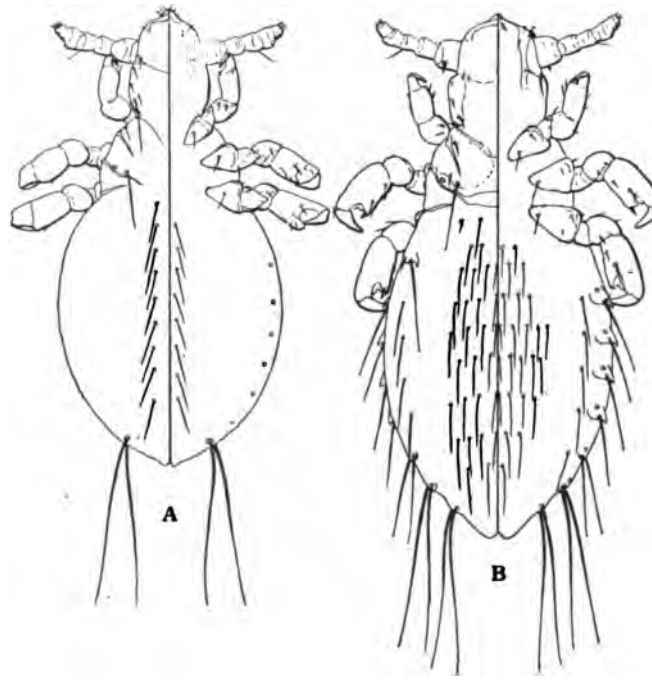

Fig. 155.—*Neohæmatopinus sciurinus* (Mjöberg): *A,* first (?) stage; *B,* second (?) stage; from specimens from the type material.

The nearest relatives of the genus appear to be *Polyplax* on the one side and *Eulinognathus* on the other. From the former it is separable chiefly by the non-divided pleural plates of the second abdominal segment and the distribution of the abdominal setæ in the male together with the emarginate second tergal plate in the male. This plate in its typical development is quite distinctive (Fig. 157*A*) and evidences of the emargination are to be seen in all the species here included under *Neohæmatopinus.* From *Eulinognathus* it is separable chiefly by the distribution of the abdominal setæ and the absence of the emarginate second tergal plate in the male of the latter.

The genus as I here understand it includes fifteen species, of which six are here described as new. Specimens of at least one sex of all the described species have been available for examination.

The immature stages are very poorly represented in my material. In Fig. 155*A* is shown what is possibly the first stage of *N. sciurinus* and in Fig. 155*B* what is possibly the second stage. Specimens of *N. lævisculus* are present which are undoubt-

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edly the same stages and which differ relatively little from those figured. It may be noted that the enlarged seta at the distal post-axial angle of the first antennal segment, which is so conspicuous in typical *sciurinus*, appears in this second (?) stage well removed from the angle.

1. Neohæmatopinus sciuropteri (Osborn).

FIGS. 156, 157.

1891. *Hæmatopinus sciuropteri* Osborn, *U. S. Dept. Agric., Div. Ent., Bull.* (o. s.) **7**: 23–4; f. 12.
1896. *Hæmatopinus sciuropteri* Osborn, Osborn, *ibid., Bull.* (n. s.) **5**: 182–3; f. 105.
1904. *Polyplax* (?) *sciuropteri* (Osborn), Enderlein, *Zool. Anz.* **28**: 143.
1908. *Polyplax* (?) sciuropteri (Osborn), Dalla Torre, "Anoplura," *Gen. Ins.* p. 14.
1910. *Neohæmatopinus sciuropteri* (Osborn), Mjöberg, *Ark. f. Zool.* **6**, 13: 160; f. 79.
1912. *Neohæmatopinus sciuropteri* (Osborn), Cummings, *Bull. Ent. Res.* **3**: 393.
1915. *Neohæmatopinus sciuropteri* (Osborn), Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.*, p. 36; pl. 1, f. 1; pl. 5, f. 2, 13.
1916. *Neohæmatopinus sciuropteri* (Osborn), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 170.
1916. *Neohæmatopinus sciuropteri* (Osborn), Ferris, *Psyche* **23**: 101–2; f. 1–2.

PREVIOUS RECORDS. From *Sciuropterus volans* (=*volucella*), Ames, Iowa (Osborn); *Sciuropterus* sp., Eureka, California (Kellogg and Ferris); *Sciuropterus* (=*Glaucomys*) *sabrinus lascivus*, Yosemite National Park, California (Ferris).

SPECIMENS EXAMINED. Those upon which the above records by Ferris, and Kellogg and Ferris were based.

FEMALE (Fig. 156). A quite elongate and slender species. Length 1.9 mm. *Head* as broad as long, broadly rounded anteriorly, with the antennæ set close to the anterior margin, with the post-antennal angles very prominent, the lateral margins of the hind head nearly straight and parallel, the occipital region greatly constricted; under side of the head with the gular region elevated; first segment of antennæ with a very stout seta about the middle. *Thorax* about as long as and but little wider than the head; sternal plate (Fig. 157*D*) somewhat kite-shaped, with the posterior angles produced.

Pleural plates as follows: plates of the first segment represented by a small, weakly chitinized piece which bears a pair of small setæ; plates of the second to sixth segments each with the posterior angles produced into a strong tooth and each with a pair of setæ on the posterior margin which are about as long as the plate; plates of the seventh and eighth segments smaller, without teeth and with a pair of moderately long setæ.

Tergal and sternal plates strongly developed, reaching nearly from pleurite to pleurite, bearing for the most part six to eight slender setæ, a plate accompanying each row of setæ.

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MALE (Fig. 156). Length 1.4 mm. *Antennæ* (Fig. 157*B*) with the first segment longer than in the female (Fig. 157*C*) and with the distal, pre-axial angle of the third segment strongly produced and bearing a pair of stout, recurved setæ.

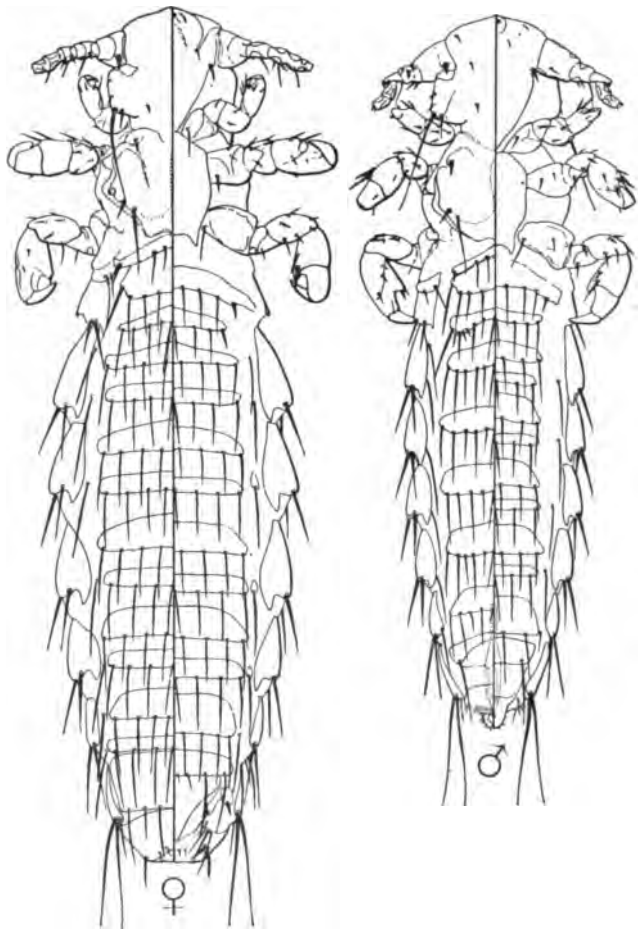

Fig. 156.—*Neohæmatopinus sciuropteri* (Osborn), male and female, from specimens from *Sciuropterus sabrinus lascivus,* California.

Tergal and sternal plates strongly developed, arranged in the typical manner, a plate accompanying each row of setæ. Second plate of the second tergite (Fig. 157*A*) strongly emarginate posteriorly, with a cluster of small setæ at each end. Tergal plates with for the most part ten to twelve setæ of variable lengths; sternal plates with for the most part five to six small setæ.

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Genitalia (Fig. 157*E*) with the basal plate (*bp*) quite long and slender; parameres (*par*) more than half as long as the basal plate, nearly straight and parallel, enclosing the ring-shaped endomeral piece (*e*), the penis (*p*) and the stout, wedge-shaped pseudopenis (*pp*).

NOTES.—This is a very distinct species, marked especially by the very broad head, the character of the antennæ, the strong development of the tergal and sternal plates of the abdomen and the genitalia of the male. Its nearest relatives are to be found in *N. sciurinus* and similar species.

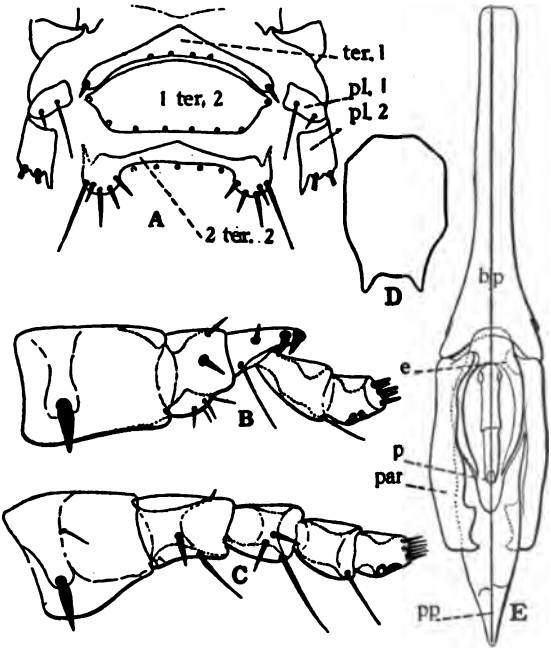

Fig. 157.—*Neohæmatopinus sciuropteri* (Osborn): *A*, tergal plates of the first and second abdominal segments; *B*, antenna of male, *C*, antenna of female; *D*, sternal plate; *E*, genitalia of male; from specimens from *Sciuropterus sabrinus lascivus*, California.

2. Neohæmatopinus sciurinus (Mjöberg).

(Synonymy under subspecies).

2a. Neohæmatopinus sciurinus sciurinus (Mjöberg).

FIGS. 155, 158, 159.

1891. *Hæmatopinus antennatus* Osborn, *U. S. Dept. Agric. Div. Ent., Bul.* **7**, o. s.: 25; f. 13 (not of Piaget).
1896. *Hæmatopinus antennatus* Osb., Osborn, *ibid., Bul.* **5**, n. s.: 183–4; fig. 106.
1904. *Polyplax* (?) *antennata* (Osb.), Enderlein, *Zool. Anz.* **28**: 143.
1908. *Polyplax* (?) *antennata* (Osb.), Dalla Torre, "Anoplura," *Gen. Ins.*, p. 13.
1910. *Acanthopinus antennatus* (Osb.), Mjöberg, *Ark. f. Zool.* **6**: 161.

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1910. *Acanthopinus sciurinus* Mjöberg, *ibid.* **6**: 161–4; figs. 80–3.
1912. *Neohæmatopinus sciurinus* (Mjöberg), Cummings, *Bull. Ent. Res.* **3**: 393.
1915. *Neohæmatopinus antennatus* (Osborn), Kellogg and Ferris, "Anoplura and Mallophaga N. Amer. Mamm.," *Stanford Univ. Publ.*, p. 36–7; tf. 14a–b; pl. 5, f. 10; pl. 6, f. 5.
1916. *Neohæmatopinus antennatus* (Osborn), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 169.
1916. *Neohæmatopinus antennatus* var. *semifasciatus* Ferris, *ibid.*, p. 169 (without description).
1916. *Linognathoides inornatus* Kellogg and Ferris, Ferris, *ibid.*, p. 158 (part; misidentification).
1916. *Neohæmatopinus antennatus* var. *semifasciatus* Ferris, *Psyche* **23**: 100.
1916. *Linognathoides inornatus* Kellogg and Ferris, Ferris, *ibid.*, p. 100.
1919. *Neohæmatopinus macrospinosus* Fahrenholz, *Jahresb. des Niedersäch. Zool. Ver.* **5–10**: 24.

Previous Records. From *Sciurus niger rufiventer* (= *S. cinerus ludovicianus*), Ames, Iowa (Osborn, types of *antennatus*); *S. niger ssp.* (= *S. vulpinus*), Zoological Garden, Hamburg, Germany (Mjöberg, types of *sciurinus*); *S. douglasi mollipilosus* and *S. douglasi albolimbatus*, California (Ferris, types of *antennatus* var. *semifasciatus*); *Neotoma fuscipes streatori*, Yosemite National Park, California (Ferris).

Specimens Examined. Several males and females and immature specimens from the type lot of *N. sciurinus*, received through the kindness of Dr. von Brunn of the Hamburg Museum, the specimens upon which the above records by Ferris were based and the following: United States: *Sciurus aberti ferreus*, Colorado Springs, Colorado (U. S. N. M. 12385); *S. carolinensis*, Bayou St. Louis, Mississippi (U. S. N. M. 23691); *S. hudsonicus richardsoni*, Florence, Montana (F. C. Bishop); *S. niger rufiventer*, Indiana and Valentine, Nebraska; "fox squirrel," Victoria, Texas. Mexico: *S. alleni*, Sierra Gaudelupe (U. S. N. M. 11691); *S. apache*, Colonia Garcia, Chihuahua (U. S. N. M. 132347); *S. aureogaster hypopyrrhus*, Quichicon, Oaxaca (U. S. N. M. 73297); *S. colliæ*, Santiago, Tepic (U. S. N. M. 91245); *S. deppei*, Teapa, Tabasco (U. S. N. M. 100048); *S. nelsoni*, Huitzilac, Morelos (U. S. N. M. 51156); *S. oculatus*, State of Vera Cruz (U. S. N. M. 54235); *S. poliopus*, Cerro San Felipe, Oaxaca (U. S. N. M. 68182); *Hodomys alleni merriami*, Manzanillo (U. S. N. M. 32706). Central America: *Sciurus æstuans hoffmani*, Santa Clara, Costa Rica (U. S. N. M.). South America: *S. versicolor zuliæ*, Rio Aurare, Venezuela (F. C. M. 18732). Asia, Malayan Region: *Sciurus borneœnsis*, Pulo Kanchut, Borneo (U. S. N. M. 142319); *S. davisoni*, Trong, Lower Siam (U. S. N. M. 83495); *S. ferrugineus cinnamomeus*, South East Siam (U. S. N. M. 201408); *S. finlaysoni folletti*, Koh Phai Island, Gulf of Siam (U. S. N. M. 201383); *S. finlaysoni portus*, Koh Si Chang Island, Gulf of Siam (U. S. N. M. 201395); *S. juvencus*, Puerto

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Princesa, Philippine Islands (U. S. N. M.); *S. procerus,* Bunguran, Natuna Islands (U. S. N. M. 104699); *Lariscus obscurus,* Pagi Island (U. S. N. M. 121644; *Menetes berdmorei rufescens,* Koh Kut Island, South East Siam (U. S. N. M. 201426); "Malaysian squirrel," Zoological Garden, London.

All the above hosts are *Sciuridæ* of the sub-family *Sciurinæ,* the "tree

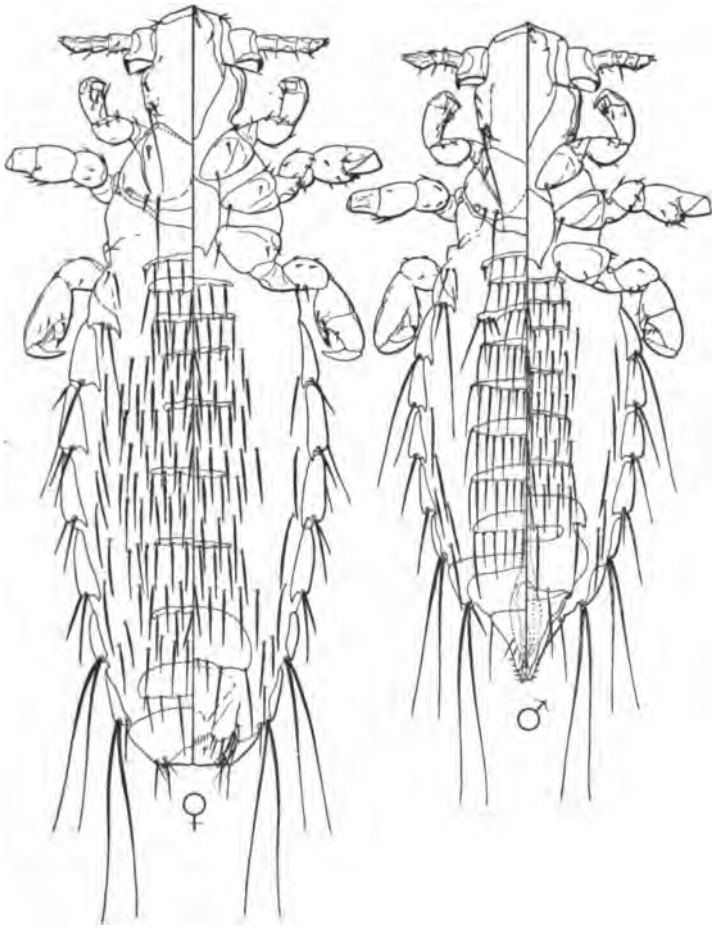

Fig. 158.—*Neohæmatopinus sciurinus* (Mjöberg), from specimens from the type lot of *sciurinus.*

squirrels," except the genera *Neotoma* and *Hodomys,* which belong to the sub-family *Cricetinæ* of the *Muridæ.*

FEMALE (Fig. 158). Length 2 mm. *Head* somewhat longer than broad, broadly rounded anteriorly with a slight median point, with the

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antennæ set close to the anterior margin; with prominent post-antennal angles and a strongly constricted occipital region, the lateral margins of the hind head nearly straight and slightly convergent; ventral side with a raised gular region. Antennæ typically with the distal, post-axial angle somewhat produced and terminating in a stout, recurved seta but varying

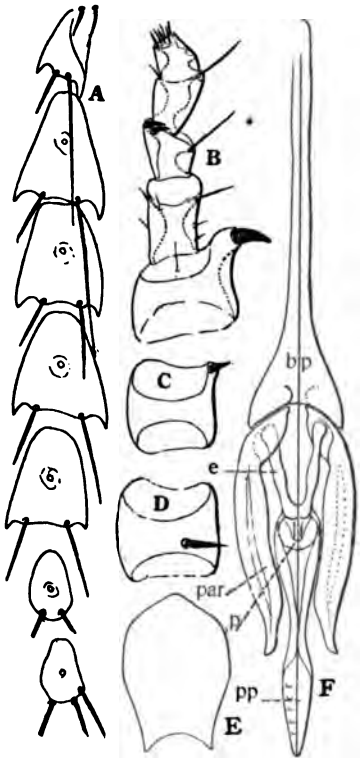

Fig. 159.—*Neohæmatopinus sciurinus* (Mjöberg): *A*, pleural plates of female; *B*, antenna of male; *E*, sternal plate; *F*, genitalia of male; from specimens from type lot of *sciurinus*; *C*, first segment of antenna from specimen from *Sciurus carolinensis*; *D*, first segment of antenna from specimen from *Neotoma fuscipes streatori*.

from this to an entire absence of this seta or with the seta reduced in size and removed from the apex of the segment.

Thorax about as long as the head and considerably wider, the lateral margins quite strongly convex; sternal plate (Fig. 159*E*) somewhat kite-shaped, with the posterior angles produced.

Pleural plates (Fig. 159*A*) as follows: plates of the first segment represented merely by a pair of small setæ; plates of the third to sixth

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segments quite large, with the posterior angles produced into a short tooth and with a pair of slender setæ which are about as long as the plate itself, except the dorsal seta on the second and third segments which is longer than the plate; plates of the seventh and eighth segments quite small, with the usual long setæ.

Tergal and sternal plates developed only in connection with the anterior row of setæ on each segment, except on the second where there are two plates both dorsally and ventrally; plates typically quite small and slender but much larger in some specimens. On the dorsum the rows of setæ are practically continuous across the abdomen and contain for the most part from eight to fourteen setæ. On the ventral side they are restricted to the median portion of the abdomen, with for the most part six to ten setæ in each row and with a single seta on each segment near the pleural plate.

MALE (Fig. 158). Length 1.5 mm. *Antennæ* strongly modified (Fig. 159*B*) the third segment with the distal pre-axial angle produced and bearing a pair of stout, recurved setæ at the apex.

Tergal plates of the abdomen strongly developed, bearing for the most part ten to fourteen slender setæ of variable lengths. *Sternal plates* developed only in connection with the anterior row of setæ except on the second segment, small and slender. Setæ confined to the median portion of the abdomen, the rows for the most part with seven to eight, the third to seventh segments with a single seta at each side near the pleurite.

Genitalia (Fig. 159*F*) with the basal plate (*bp*) long and slender and slightly expanded at the apex; parameres (*par*) more than half as long as the basal plate, tapering, nearly parallel, enclosing the small, U-shaped endomeral piece (*e*), the penis (*p*) and the pseudopenis (*pp*). The pseudopenis is somewhat compressed Y-shaped, with the arms slender, the shaft longer than the arms and somewhat lanceolate with the terminal portion transversely ridged.

NOTES.—The specific name *antennatus* having previously been used in the genus *Hæmatopinus* is invalid as applied to the species here under discussion. Fahrenholz has proposed to replace it by the name *macrospinosus* but the species described by Mjöberg as *sciurinus* appears certainly to be identical with Osborn's *antennatus* and therefore the name *macrospinosus* becomes unnecessary and a synonym.

Through the kindness of Dr. von Brunn of the Hamburg Museum I have been enabled to examine specimens from the type lot of *sciurinus* and as specimens from the type host of *antennatus* are at hand I feel no hesitation in placing the two as the same. As to the many other specimens that I am referring to this species, however, there is certainly room for abundant argument.

Typically the first antennal segment in this species has the distal post-axial angle strongly produced and terminating in a very stout, recurved seta, yet I am including in this species specimens in which this seta is even entirely absent or in some cases is far removed from the apex of the segment. Certainly if only these extremes were

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available it would seem absurd to unite them under a single species yet I am compelled to this step by the fact that there exists a complete series of intergrades between these two extremes, a series so finely graded that it would be impossible to assign any definite limits were it broken up. Nor are these differences connected with any others that can be of aid in specific differentiation for the only apparent variations are in slight differences in the size of the tergal and sternal plates of the abdomen and in the number of the abdominal setæ.

If the specimens be arranged according to host in a series beginning with those in which the development of this seta is most extreme we have an arrangement as follows. The specimens from *Sciurus æstuans* have the seta even larger than in typical examples. These are followed by part of those from the type host and those from *S. alleni, aureogaster, hudsonicus, colliæ, oculatus, davisoni, lancavensis,* and "Malaysian squirrel" which are nearly typical. The specimens from *S. nelsoni, apache, procerus,* and *Lariscus obscurus* have the seta somewhat reduced in size. Those from *S. carolinensis* (Fig. 159*C*), *finlaysoni, ferrugineus, deppei* and *poliopus* have the seta much reduced in size. Those from *S. borneœnsis, juvencus* and *aberti* have the seta very minute. In part of those from the type host, *S. niger* (Valentine, Nebraska), and in those from *Menetes berdmorei* it appears to be absent. In those from *S. versicolor* and from the two Murid genera *Neotoma* and *Hodomys* the seta is somewhat enlarged but is near the base of the segment and not at the distal post-axial angle (Fig. 159*D*).

It will be seen from this that there is apparently no constant geographical arrangement in the series and further that in at least one host species, *S. niger,* and that the host of the type both extremes are to be found. In the face of this there appears to be no alternative but to refer all the specimens to a single species. In such cases as this the only solution of the problem lies in the highly difficult approach by the methods of the geneticist.

N. sciurinus was made the type of the genus *Acanthopinus* by Mjöberg but there seems to be no reason for recognizing this genus.

2b. Neohæmatopinus sciurinus griseicolus n. ssp.

1915. *Neohæmatopinus antennatus* (Osborn), Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.,* p. 36–7; tf. 14 A–B; pl. 5, f. 10; pl. 6, f. 5 (part; misidentification).

1916. *Neohæmatopinus antennatus* (Osborn), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 169 (part).

PREVIOUS RECORDS. From *Sciurus griseus* (=*S. fossor nigripes*), Inverness, Marin County; Freestone, Sonoma County, Mount Sanhedrin, Mendocino County, and Mount Hamilton, California.

SPECIMENS EXAMINED. Only as above recorded. Holotype, a female, and allotype from Freestone, Sonoma County.

NOTES.—This form differs from typical *N. sciurinus* only in the complete absence of tergal and sternal plates on the abdomen of the female except for the tergal plates of the first, second, eighth and ninth segments, the sternal plates of the second segment and the genital plate. The male appears not to differ from the typical form. The seta at the distal post-axial angle of the first antennal segment is very strongly developed.

It is possible that further work will show that this form should not be recognized.

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3. Neohæmatopinus pacificus Kellogg and Ferris.

FIGS. 160*A-D*.

1915. *Neohæmatopinus pacificus* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.*, p. 38–40; tf. 14C, D; pl. 1, f. 2; pl. 5, f. 3, 7a-b.

1916. *Neohæmatopinus pacificus* Kellogg and Ferris, Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 170.

1916. *Neohæmatopinus pacificus* Kellogg and Ferris, Ferris, *Psyche* **23**: 100.

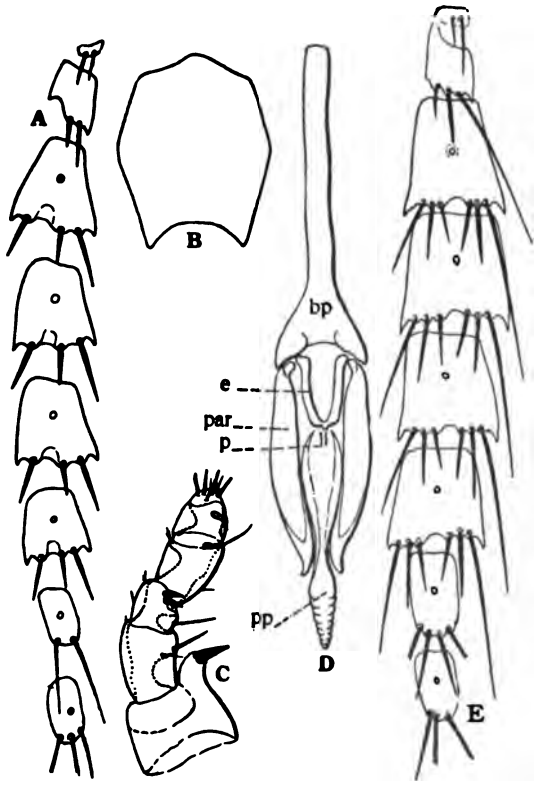

Fig. 160.—*Neohæmatopinus pacificus* Kellogg and Ferris: *A*, pleural plates; *B*, sternal plate; *C*, antenna of male; *D*, genitalia of male; from paratypes. *Neohæmatopinus syriacus* n. sp.: *E*, pleural plates of female.

PREVIOUS RECORDS. Types from *Eutamias towsendi ocrogenys*, Freestone, Sonoma County, California. Also from *Eutamias hindsi*, Cazadero, Sonoma County, *E. merriami pricei*, Stanford University, *E. alpinus* and *E. speciosus frater*, Yosemite National Park, *Eutamias* sp., South Yolla Bolly Mt., and *Eutamias* sp., Mount Sanhedrin, Mendocino County, California.

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The hosts are *Sciurids,* commonly known as "chipmunks."

NOTES.—This species, in general appearance is practically indistinguishable from *N. sciurinus* but it differs sharply in the character of the pleural plates (Fig. 160*A*), those of the third to sixth segments having two stout setæ, which are shorter than the plate on the dorsal lobe and one on the ventral lobe. The antennæ (Fig. 160*C*), sternal plate (Fig. 160*B*) and genitalia of the male (Fig. 160*D*) are practically as in typical *sciurinus.* The species is smaller than typical *sciurinus,* the female being about 1.4 mm. long and the male 1 mm.

4. Neohæmatopinus syriacus n. sp.

FIG. 160*E*.

SPECIMENS EXAMINED. But two specimens, the holotype, a male, from *Sciurus syriacus,* North Syria (U. S. N. M. 13511), and a female from the same host species, Soumela, Asia Minor (U. S. N. M. 152748).

FEMALE. Length 1.5 mm. In general practically identical with typical *N. sciurinus* as figured (Fig. 158). Differing significantly only in the character of the pleural plates (Fig. 160*E*); plates of the second segment with three setæ of which the dorsal is long and slender and the others shorter than the plate; plates of the third to sixth segments each with three setæ on each lobe, the ventral seta being about as long as the plate, the four middle setæ about half as long as the plate, the dorsal setæ slender and longer than the plate; plates of the seventh segment with the usual slender setæ and with a pair of short setæ; plates of the eighth segment with the usual slender setæ and with one short seta.

MALE. Length 1.3 mm. Practically identical with the male of typical *N. sciurinus* in every respect except for the pleural plates which differ as in the female.

5. Neohæmatopinus echinatus (Neumann).

FIG. 161.

1909. *Hæmatopinus* (*Polyplax*) *echinatus* Neumann, *Arch. de Parasit.* 13: 517–21; f. 19–20.

1912. *Neohæmatopinus echinatus* (Neum.), Cummings, *Bull. Ent. Res.* 3: 393.

1916. *Neohæmatopinus echinatus* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) 6: 170

PREVIOUS RECORDS. Known only from the original record, from *Funambulus* (=*Sciurus*) *palmarum,* Rajkote, India, and, undoubtedly as an erroneous record, from a bat, *Scotophilus wroughtoni,* Navapour, India.

SPECIMENS EXAMINED. A single male from *Funambulus tristriatus tristriatus,* Colombo, Ceylon (U. S. N. M. 114084).

MALE (Fig. 161*A*). Length 1.52 mm. *Head* as broad as long, smoothly rounded in front and with the antennæ set very close to the anterior margin, with the post-antennal angles very prominent and with

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a much constricted occipital region, the lateral margins of the hind head nearly straight and slightly convergent. Ventral side of the head with the gular region elevated. In the angle, just behind the base of the antennæ, is a conspicuous chitinized spot. Antennæ with the first segment elongated and bearing a slightly enlarged seta near the distal post-axial angle; with the third segment strongly modified.

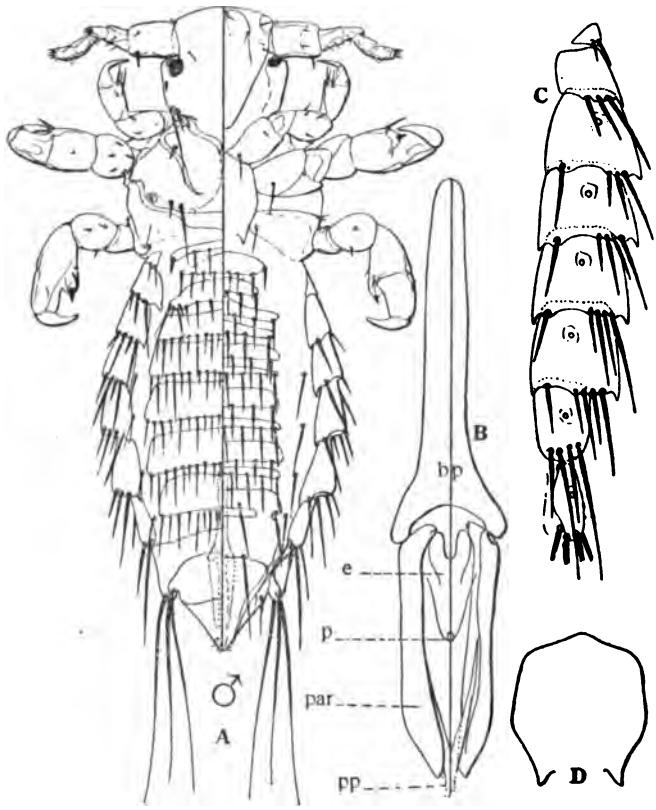

Fig. 161.—*Neohæmatopinus echinatus* (Neumann): *A*, male; *B*, genitalia of male; *C*, pleural plates; *D*, sternal plate; from specimen from *Funambulus tristriatus tristriatus*, Colombo, Ceylon.

Thorax about as long as the head and much broader; sternal plate (Fig. 161*D*) rather short and broad, somewhat kite-shaped.

Pleural plates (Fig. 161*C*) as follows: plates of the first segment represented merely by a small, chitinized area bearing a pair of small setæ; plates of the second segment with a small tooth at the dorsal posterior angle and with three setæ on the posterior margin; plates of the

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third to sixth segments each with a small tooth at each posterior angle, with a single seta on the ventral lobe and four stout setæ on the dorsal lobe; plates of the seventh segment with two moderately long and two shorter setæ; plates of the eighth segment with three very long and one short seta.

Tergal and sternal plates of the abdomen present in connection with each row of setæ, both dorsally and ventrally, the rows of setæ arranged in the typical manner. Tergal plates very large, occupying the greater part of the dorsal surface and bearing for the most part as many as twenty small slender setæ. Sternal plates slender, for the most part with six or seven setæ.

Genitalia (Fig. 161*B*) with the basal plate (*bp*) slender, expanded posteriorly; parameres (*par*) more than half as long as the basal plate, nearly parallel; enclosing the small pseudopenis (*pp*), the penis (*p*) and a vague endomeral piece (*e*).

FEMALE. According to the original description the female has the abdominal setæ arranged in the normal manner, but nothing is said as to the development of the plates. Length 1.94 mm. according to Neumann.

NOTES.—This is a very distinctive species, the form of the antennæ, the broad head and the character of the pleural plates marking it at once. It is possible that the specimen examined by me is not really referable to *echinatus* for according to Neumann's description and figures the fourth to sixth segments have three or four setæ on the ventral lobe instead of one. In all other respects, however, my single specimen agrees exactly with *echinatus* and being from a host of the same genus and from the same region there is good reason for accepting it as that species.

6. **Neohæmatopinus inornatus** (Kellogg and Ferris).

FIGS. 162, 163.

1915. *Linognathoides inornatus* Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.*, p. 25–7; tf. 10; pl. 2, f. 1; pl. 4, f. 7; pl. 5, f. 5; pl. 6, f. 3.

1916. *Linognathoides inornatus* Kellogg and Ferris, Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 158 (part).

1916. *Linognathoides inornatus* Kellogg and Ferris, Ferris, *Psyche* **23**: 100 (part).

PREVIOUS RECORDS. Type from *Neotoma cinerea occidentalis*, South Yolla Bolly Mountain, Tehama County, California. Also from *N. cinerea cinerea*, Yosemite National Park, California. Specimens doubtfully recorded as this species by Ferris, from *N. fuscipes streatori*, are here referred to *N. sciurinus*.

The hosts are *Muridæ*, commonly known as "bushy tailed wood rats."

SPECIMENS EXAMINED. Those upon which the above records are based.

FEMALE (Fig. 162). Length 1.6 mm. *Head* slightly longer than

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broad, smoothly rounded anteriorly; with the antennæ set close to the anterior margin; with the post-antennal angles rounded, with a distinctly constricted occipital region and with the lateral margin of the hind head somewhat convex. Ventral side of the head with the gular region slightly

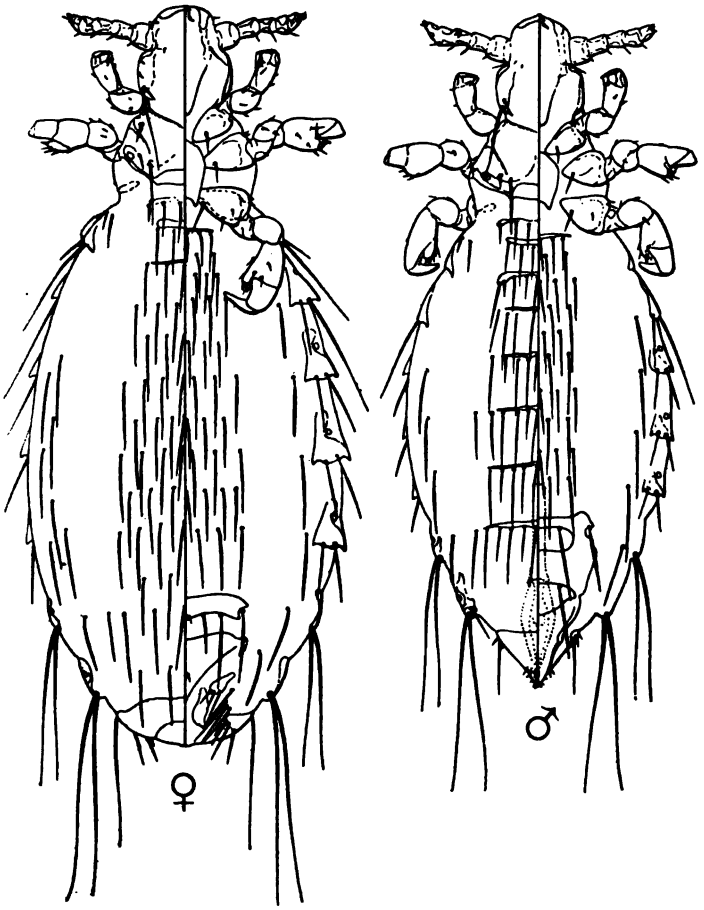

Fig. 162.—*Neohæmatopinus inornatus* (Kellogg and Ferris), male and female, from the types.

elevated. Antennæ without an enlarged seta at the distal post-axial angle of the first segment.

Thorax shorter than the head and somewhat broader; sternal plate (Fig. 163*A*) more or less kite-shaped, with the posterior angles prolonged.

Pleural plates quite small, each with a pair of slender setæ on the posterior margin, the dorsal seta of the second and third segments much

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longer than the others, the seventh and eighth segments with the usual long setæ.

Tergal and sternal plates of the abdomen entirely lacking except for the ninth tergite, the genital plate and faint vestiges on the first and second tergites and the second sternite. Rows of setæ arranged in the normal manner, with a median group of five to seven in each row and one or two near each lateral margin on the third to seventh segments.

MALE (Fig. 162). Length 1.3 mm. *Antennæ* (Fig. 163*B*) with the third segment very slightly modified and bearing a pair of small, stout recurved setæ.

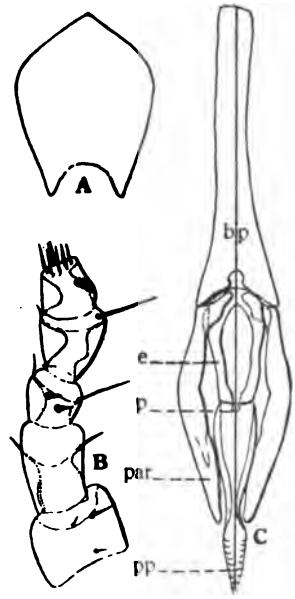

Fig. 163.—*Neohæmatopinus inornatus* (Kellogg and Ferris): *A*, sternal plate; *B*, antenna of male; *C*, genitalia of male; from the types.

Tergal plates very small and slender, the second plate of the second segment slightly but distinctly emarginate. *Sternal plates* lacking except for the genital plate and the first plate of the second segment. Setæ arranged in the typical manner, the dorsal rows with ten to twelve in a median group and with a single seta near the margin on the fourth to seventh segments, the ventral rows with four or five in a median group and a single seta near the margin on the third to seventh segments.

Genitalia (Fig. 163*C*) with the basal plate (*bp*) slender, expanded but little posteriorly, the parameres (*par*) three-fourths as long as the basal plate, tapering and slightly curved, enclosing a ring-shaped endomeral

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piece (*e*), the penis (*p*) and the pseudopenis (*pp*). The latter is of compressed Y-shape, with the shaft lanceolate and transversely ridged.

NOTES.—This species is unquestionably a member of the *sciurinus* group, in spite of the apparent anomaly in the host. It is readily distinguishable by the unmodified antennæ, the absence of the tergal and sternal plates in the female and their weak development in the male and the small size of the pleural plates.

Specimens from *Neotoma fuscipes streatori,* which I have previously referred to this species certainly do not belong with it and I am referring them to *N. sciurinus.*

7. **Neohæmatopinus heliosciuri** Cummings.

FIGS. 164, 165*A*, 165*C*, 165*E*, 165*H*.

1912. *Neohæmatopinus heliosciuri* Cummings, *Bull. Ent. Res.* **3**: 393–5; f. 1.
1916. *Neohæmatopinus heliosciuri* Cumm., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 170.

PREVIOUS RECORDS. From *Paraxerus* (=*Heliosciurus*) *palliatus,* Uchweni Forest, Witu, British East Africa.

SPECIMENS EXAMINED. From *Paraxerus palliatus suahelicus,* British East Africa (U. S. N. M. 182794); *P. jacksoni capitis,* British East Africa (U. S. N. M. 182795) and Kijabe, British East Africa (F. C. M. 16747); *Parasciurus animosus,* Mt. Lololokwi, British East Africa (U. S. N. M. 182776). The hosts are the so-called "scrub-squirrels."

FEMALE (Fig. 164). Length 1.7 mm. *Head* as broad as long, slightly pointed in front with the antennæ set close to the anterior margin; with rounded post-antennal angles and a distinctly constricted occipital region and with the lateral margins of the hind head convex. Under side of the head with a raised gular region. Antennæ with the distal post-axial angle of the first segment slightly produced and bearing a short stout seta.

Thorax about as long and considerably broader than the head; sternal plate (Fig. 165*C*) large and broad.

Pleural plates (Fig. 165*A*) as follows: plates of the first segment very small and obscure, bearing a pair of small setæ; plates of the second segment with a small tooth at each posterior angle and with a pair of slender setæ; plates of the third to sixth segments large, with a quite long, acute tooth at each posterior angle and a pair of slender setæ about as long as the plate; plates of the seventh and eighth segments very small, without teeth, bearing the usual long setæ.

Tergal and sternal plates of the abdomen strongly developed, reaching nearly from pleurite to pleurite and arranged in a manner unusual for the genus, the second to seventh tergites and the second to seventh sternites each with three plates, the remainder with one, bearing for the most part eight to ten small setæ. Sternal plate of the second segment longer than the others, extending practically entirely across the abdomen.

MALE (Fig. 164). Length 1 mm. *Antennæ* (Fig. 165*E*) with the

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third segment somewhat modified and bearing a single stout, recurved seta on the dorsal surface.

Tergal and sternal plates of the abdomen arranged in the manner typical of the genus. Tergal plates large, bearing for the most part

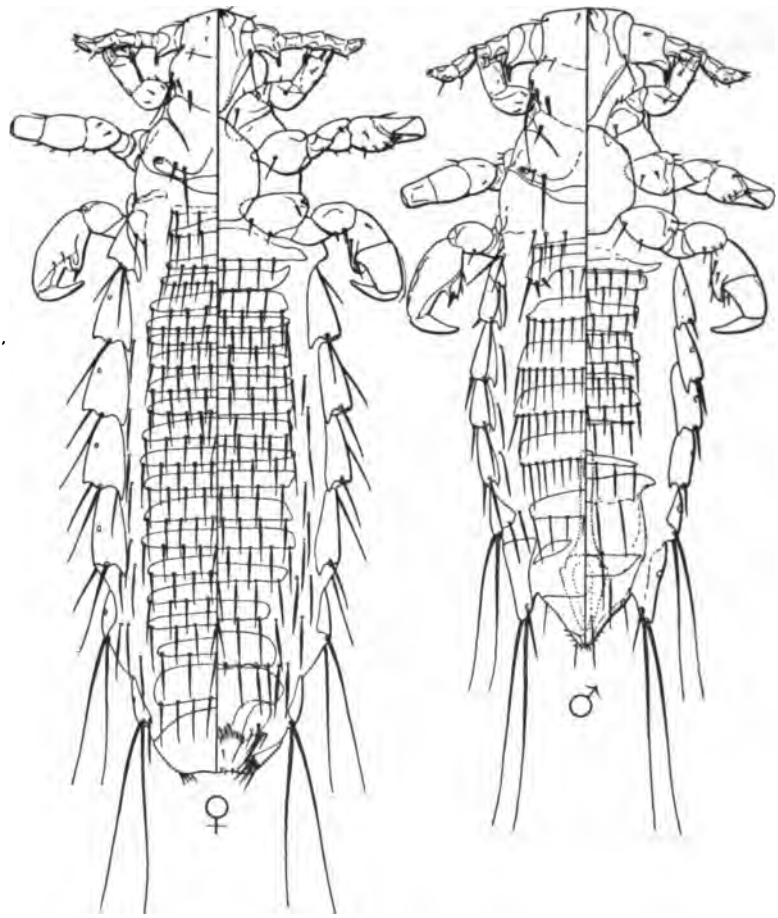

Fig. 164.—*Neohæmatopinus heliosciuri* Cumm., male and female, from specimens from *Paraxerus palliatus suahelicus*.

fourteen to eighteen small setæ of varying lengths. Sternal plates slender, bearing six or seven setæ, the anterior plate of the fourth to sixth segments much more slender than the posterior.

Genitalia (Fig. 165*H*) with the basal plate (*bp*) slender, slightly expanded at the posterior end; parameres (*par*) slightly more than half as long as the basal plate, nearly parallel, each with a prominent lateral

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shoulder near the base, the outline of the two together nearly triangular. Between the parameres is a small U-shaped endomeral piece (*e*), the penis (*p*) and the slender V-shaped pseudopenis (*pp*).

NOTES.—This is a very distinctive species, that may be regarded as the type of a group which occurs on the African "scrub squirrels." This group, which includes two species here described as new, is distinguished by the presence of three tergal and sternal plates on the majority of the abdominal segments of the female, a character that is strongly reminiscent of the genus *Hoplopleura*. However the male is entirely as in typical *Neohæmatopinus*.

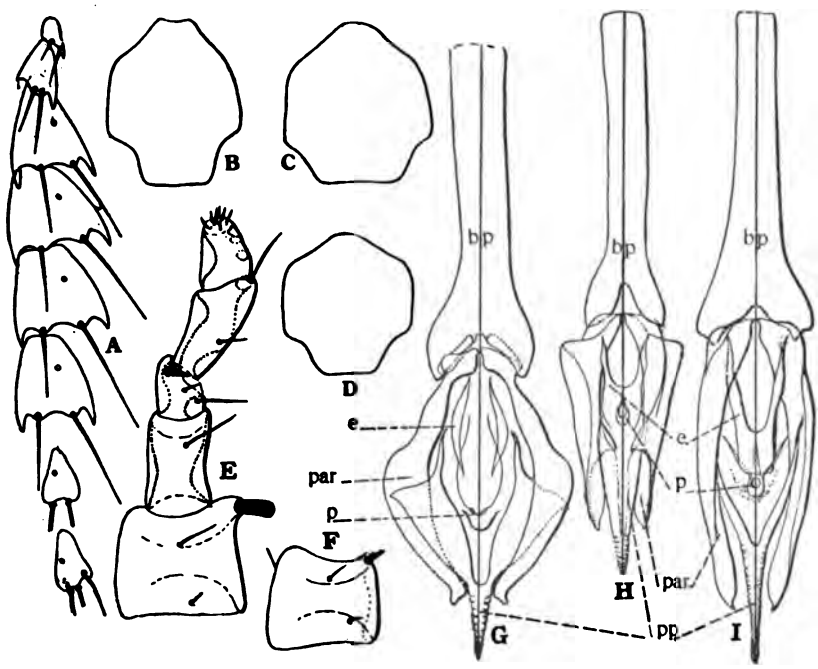

Fig. 165.—*Neohæmatopinus heliosciuri* Cumm.: *A*, pleural plates of female; *C*, sternal plate; *E*, antenna of male; *H*, genitalia of male; from specimens from *Paraxerus palliatus suahelicus*. *Neohæmatopinus suahelicus* n. sp.: *B*, sternal plate; *F*, first segment of antenna; *G*, genitalia of male; from the types. *Neohæmatopinus keniæ* n. sp.: *D*, sternal plate; *I*, genitalia of male; from type.

The three species of this group that I am recognizing are somewhat puzzling. It is possible that there has been some mixing in my material but if not they appear to be more or less indiscriminately present on several host species, at least two of the three species often occurring together. The males are readily distinguishable by the form of the genitalia but the females are so very similar that I have not in all cases been certain as to just which male they belong with.

N. heliosciuri is marked in the female by the strongly modified seta of the first antennal segment, while the male is distinguished by this and by the sharp shoulders of the parameres and the form of the pseudopenis. It seems to be clear from Cummings' figures and description that the form so marked is his *heliosciuri*.

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8. Neohæmatopinus suahelicus n. sp.

FIGS. 165*B*, 165*F*, 165*G*.

SPECIMENS EXAMINED. Holotype, a male, and allotype, from *Paraxerus palliatus suahelicus*, British East Africa (U. S. N. M. 182804). Also from *P. palliatus ornatus*, Ngoye Hills, Zululand (U. S. N. M. 141472), *P. jacksoni capitis*, Kijabe, British East Africa (F. C. M. 16747), and *Parasciurus animosus*, Mt. Lololokwi, British East Africa (U. S. N. M. 182776).

FEMALE. Apparently differing from the female of *N. heliosciuri* only in having the seta of the distal post-axial angle of the first antennal segment strongly reduced (Fig. 165*F*) or even absent and in having the sternal plate of the thorax (Fig. 165*B*) slightly more elongate and more produced posteriorly.

MALE. Differing from the male of *N. heliosciuri* in the same characters as above enumerated and in the form of the genitalia. These (Fig. 165*G*) have the parameres (*par*) strongly curved, the two together forming an oval, and the pseudopenis (*pp*) broadly Y-shaped with the arms flattened and expanded.

9. Neohæmatopinus keniæ n. sp.

FIGS. 165*D*, 165*I*.

SPECIMENS EXAMINED. Holotype, a male, from *Heliosciurus keniæ*, Mt. Kenia, British East Africa, and one paratype male from *H. ruwenzorii*, Mubuku Valley, Mt. Ruwenzori, British East Africa (U. S. N. M. 172921).

MALE. Differing from the male of *N. heliosciuri* in having the seta of the distal post-axial angle of the first antennal segment very small and in the form of the genitalia. These (Fig. 165*I*) have the parameres (*par*) long and slender, without a lateral shoulder near the base, and the pseudopenis elongate Y-shaped. The sternal plate of the thorax is somewhat more angular and somewhat shorter and broader than in *heliosciuri* and *suahelicus*.

FEMALE. Not definitely recognized.

10. Neohæmatopinus petauristæ n. sp.

FIGS. 166, 167*A*, 167*C-E*.

SPECIMENS EXAMINED. From *Petaurista inornata*, Kashmir (U. S. N. M.). Holotype a female. The host is a "flying squirrel."

FEMALE (Fig. 166). Length 2.3 mm. *Head* somewhat longer than broad, acutely rounded in front with the antennæ set somewhat back from the apex; with the post-antennal angles practically obsolete, with a dis-

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tinctly constricted occipital region and with the lateral margins of the head nearly straight and parallel. Ventral side of the head with a raised gular region. Antennæ with a quite long, slender seta at the distal post-axial angle of the first segment. *Thorax* considerably shorter than the head; sternal plate (Fig. 167*D*) irregularly seven-sided.

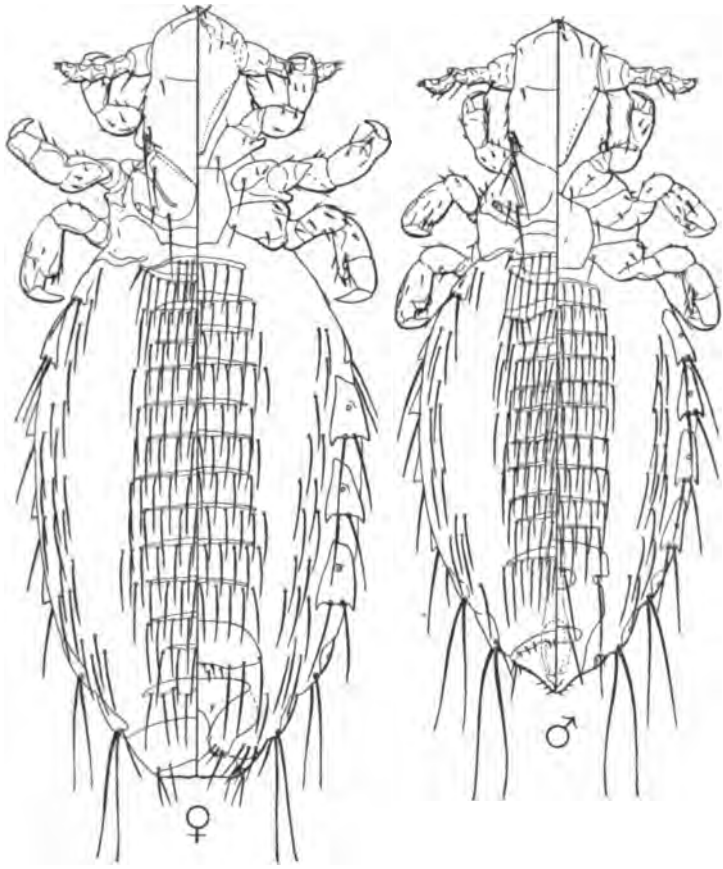

Fig. 166.—*Neohæmatopinus petauristæ* n. sp., male and female.

Pleural plates (Fig. 167*A*) as follows: plates of the first segment obsolete, their position marked by three slender setæ; plates of the second segment with a small dorsal tooth and a pair of long setæ; plates of the third to sixth segments rather narrow, each with an acute tooth at each posterior angle and with a pair of setæ which are somewhat longer than the plate itself; plates of the seventh and eighth segments small, without teeth and with the usual slender setæ.

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Tergal and sternal plates of the abdomen slender, occupying the median half of the body, arranged in the typical manner, for the most part with seven to ten slender setæ. Each segment, except the first ventral, with from one to three setæ near the margin opposite the end of each row of setæ.

MALE (Fig. 166). Length 1.8 mm. *Antennæ* (Fig. 167*C*) with the third segment somewhat modified and bearing a pair of stout, recurved setæ.

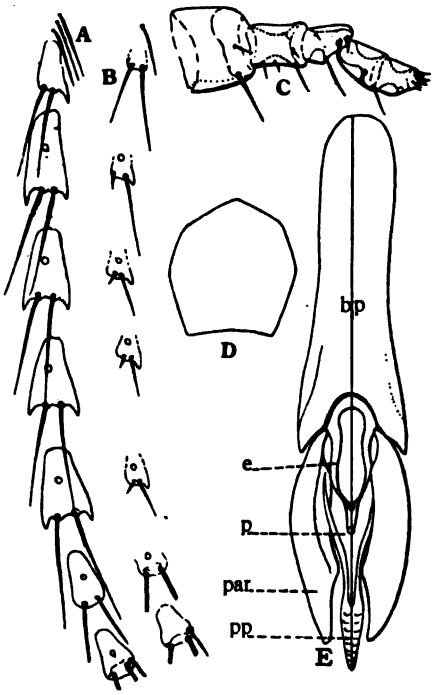

Fig. 167.—*Neohæmatopinus petauristæ* n. sp.: *A*, pleural plates; *C*, antenna of male; *D*, sternal plate; *E*. genitalia of male. *Neohæmatopinus batuanæ* n. sp.: *B*, pleural plates.

Tergal and sternal plates of the abdomen departing from the typical arrangement in that there are two rows instead of one on the third to sixth tergites. Second plate of the second tergite distinctly emarginate. All the plates slender, occupying about the median half of the body. Setæ much as in the female.

Genitalia (Fig. 167*E*) with the basal plate (*bp*) moderately broad, but little expanded at the apex; parameres (*par*) more than half as long as the basal plate, stout, somewhat curved but nearly parallel, enclosing the ring-shaped endomeral piece (*e*), the penis (*p*) and the pseudopenis (*pp*).

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the last is slender Y-shaped with the arms very slender, the shaft lanceolate and transversely ridged.

NOTES.—In the arrangement of the tergal plates of the male this species departs sharply from the typical form of this genus, yet it seems undoubtedly to belong here in spite of this. It is a very distinctive form that is approached closely only by the next species, which is likewise from a flying squirrel. Neither of these two species at all closely approaches *N. sciuropteri,* which occurs on the New World flying squirrels.

11. Neohæmatopinus batuanæ n. sp.

FIG. 167*B*.

SPECIMENS EXAMINED. From *Petaurista batuana,* Batu Islands, Malaysia (U. S. N. M.). Holotype a female.

FEMALE. Length 1.8 mm. Closely resembling the female of *N. petauristæ* in general appearance but with the tergal and sternal plates of the abdomen entirely obsolete except for the genital plate and the tergites of the first, second, and ninth segments. *Pleural plates* (Fig. 167*B*) very small and weakly developed, those of the third to sixth segments with the ventral seta very small and the dorsal scarcely longer than the plate.

MALE. Length 1.3 mm. Closely resembling the male of *N. petauristæ* but differing in the pleural plates as does the female and in the entire absence of chitinized tergal and sternal plates on the abdomen except for the genital plate and the tergal plates of the first and second segments.

NOTES.—While this species is evidently closely related to *N. petauristæ* the differences given above seem to mark it as sufficiently distinct.

12. Neohæmatopinus citelli (Cummings).

FIGS. 168, 169.

1914. *Linognathoides spermophili* Cummings, *Bull. Ent. Res.* **5**: 160–3; tf. 3 (not of Grube).
1916. *Linognathoides citelli* Cumm., *Annals and Mag. Nat. Hist.* (8) **17**: 107.
1916. *Linognathoides citelli* Cumm., Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 158.

PREVIOUS RECORDS. From *Citellus leptodactylus* and (probably as straggler) from *Cricetulus phæus,* Transcaspia. The first named, which is in all probability the normal host, is a *Sciurid* of the sub-family *Citellinæ,* the second a *Murid* of the sub-family *Cricetinæ.*

SPECIMENS EXAMINED. A female and a male from the type lot, from *Citellus leptodactylus,* received through the kindness of Mr. James Waterston.

FEMALE (Fig. 168). A stout bodied species. Length 1.8 mm. *Head* (Fig. 172*B*) somewhat longer than broad, acutely rounded in front of the antennæ, which are set well back from the apex, with the post-antennal

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angles very prominent and acute, with no constricted occipital region, the lateral margins of the hind head strongly convergent; all chitinized areas very strongly marked. Ventral side of the head without a raised gular region. Antennæ without a modified seta on the first segment. *Thorax* shorter than the head and not greatly wider; sternal plate not chitinized.

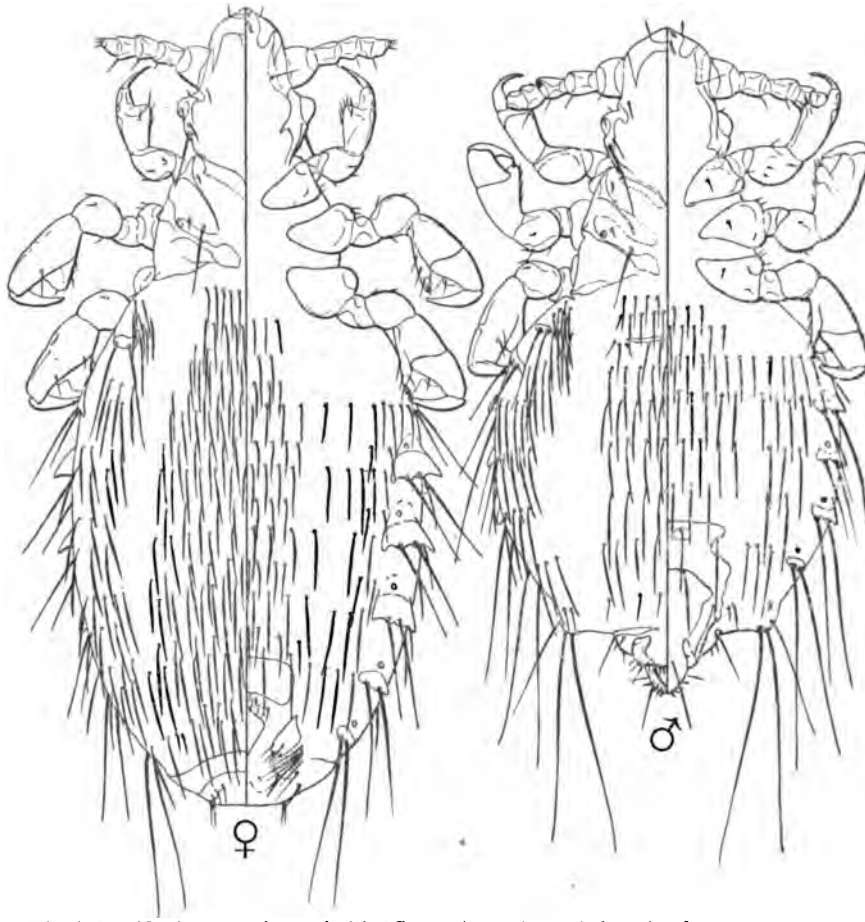

Fig. 168.—*Neohæmatopinus citelli* (Cumm.), male and female, from co-types.

Pleural plates (Fig. 169*A*) as follows: first pair lacking; second very small, oval, bearing a pair of long setæ; third to sixth pairs relatively small, with a prominent tooth at each posterior angle and with a pair of long setæ; seventh and eighth very small, each with a pair of long setæ.

Tergal and sternal plates of the abdomen entirely obsolete except for the genital plate and the ninth tergite. Rows of setæ arranged in the

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normal manner. Tergal rows divided into median and lateral groups, the lateral groups with from two to four setæ, the median group with for the most part ten to fifteen slender setæ. Ventral rows extending, with irregular interruptions across the body except on the second segment and the first row of the third where the setæ are confined to the median region, the rows with for the most part twelve to twenty slender setæ.

MALE (Fig. 168). Length 1.2 mm. *Antennæ* with a stout seta on the dorsal aspect of the apical, pre-axial angle of the third segment.

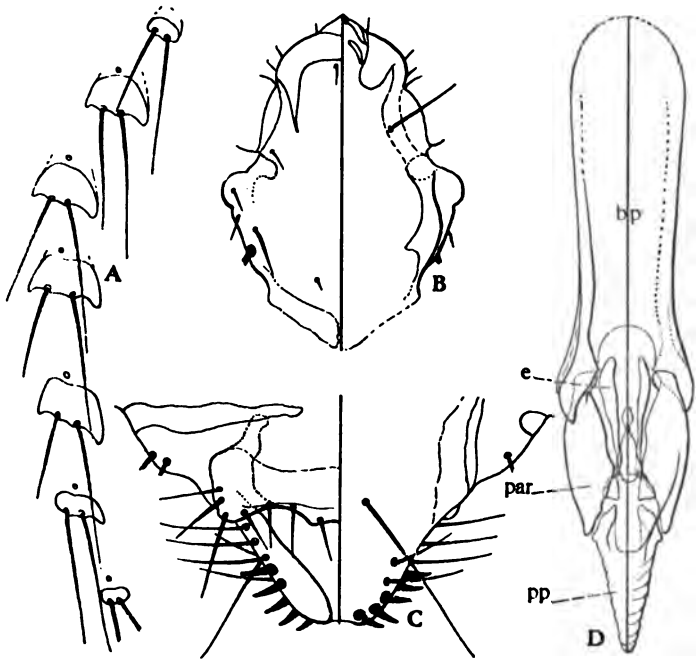

Fig. 169.—*Neohæmatopinus citelli* (Cumm.): *A*, pleural plates; *B*, head; *C*, apex of abdomen of male; *D*, genitalia of male.

Tergal and sternal plates of the abdomen entirely lacking except for faint vestiges of the second plate of the second tergite, the setæ of this row, however, still showing faint but definite indications of the usual emargination. Dorsal setæ arranged in the typical manner, those of the median group slightly fewer than in the female. Setæ of the ventral side departing from the arrangement normal in the genus in that there appears to be but a single row on each segment. Tip of the abdomen (Fig. 169*C*) with a pair of flaps which bear several short, stout setæ.

Genitalia (Fig. 169*D*) with the basal plate (*bp*) moderately stout; parameres (*par*) short, stout, and nearly parallel, enclosing a narrowly

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U-shaped endomeral piece (*e*) and an irregular statumen penis (*sp*) and articulating at the tips with the stout, wedge-shaped pseudopenis (*pp*) which is transversely striate.

NOTES.—This species is the type of the genus *Linognathoides* and if the inclusion of this genus in *Neohæmatopinus* be objected to *Linognathoides* may be restored, although I am unable at present to see upon what grounds it can be separated. It is true that *N. citelli* appears to depart rather widely from the type of *Neohæmatopinus* yet the essential characters of the genus remain. The male is the most disturbing, owing to the presence of but a single row of setæ on each abdominal sternite, yet in the face of the evident relationship with *N. læviusculus* this can hardly be given any weight.

N. citelli is evidently close to *N. læviusculus* but it is readily separable by the form of the head, of the pleural plates and the genitalia as well as by the absence of a thoracic sternal plate.

This was originally described under the name of *Linognathoides spermophili*, this name later being changed by Cummings because of the previous use of *citelli* for the species now called *læviusculus*. There might be some question as to the correctness of this since the name *citelli* was used only in connection with Grube's figure of the species, the name *læviusculus* being used in the text but the change is apparently necessary under the rules of the International Code.

13. Neohæmatopinus læviusculus (Grube).

FIGS. 170, 171*A*, 171*B*, 171*D*, 171*G*.

1851. *Pediculus læviusculus* Grube, "Middendorff's Reise," **2**: 498.
1851. *Pediculus spermophili* Grube, *ibid.* pl. 32, f. 5.
1874. *Hæmatopinus læviusculus* (Grube), Giebel, "Insecta Epizoa," p. 38.
1880. *Hæmatopinus læviusculus* (Grube), Piaget, "Les Pediculines," p. 641.
1896. *Hæmatopinus montanus* Osborn, *U. S. Dept. Agric., Div. Ent. Bul.* **5**, n. s.: **184**; f. 107.
1900. *Hæmatopinus columbianus* Osborn, *Can. Ent.* **32**: 215–6.
1904. *Polyplax læviuscula* (Grube), Enderlein, *Zool. Anz.* **28**: 142.
1904. *Polyplax columbiana* (Osb.), Enderlein, *ibid.* **28**: 143.
1904. *Polyplax* (*?*) *montana* (Osb.), Enderlein, *ibid.* **28**: 143.
1908. *Polyplax læviuscula* (Grube), Dalla Torre, "Anoplura," *Gen. Ins.* p. 13.
1908. *Polyplax columbiana* (Osb.), Dalla Torre, *ibid.* p. 13.
1908. *Polyplax* (*?*) *montana* (Osb.), Dalla Torre, *ibid.* p. 13.
1910. *Polyplax læviuscula* (Grube), Mjöberg, *Ark. f. Zool.* **6**: 160.
1914. *Linognathoides* (*?*) *columbianus* (Osb.), Cummings, *Bul. Ent. Res.* **5**: 160.
1915. *Linognathoides montanus* (Osb.), Kellogg and Ferris, "Anoplura and Mall. N. Amer. Mamm.," *Stanford Univ. Publ.* pp. 24–5; tf. 9; pl. 5, f. 1; pl. 6, f. 4.
1916. *Linognathoides læviusculus* (Grube), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 158.
1916. *Linognathoides montanus* (Osb.), Ferris, *ibid.* p. 159 (part).
1916. *Linognathoides montanus* (Osb.), Ferris, *Psyche* **23**: 99–100.
1916. *Enderleinellus læviusculus* (Grube), Fahrenholz, *Archiv f. Naturges.* **81**, 11: 29.

PREVIOUS RECORDS. From *Citellus* (=*Spermophilus*) *eversmanni*, Jakutsk, Siberia (Grube) and "Pitlekaj" (Mjöberg); *Citellus* (=*Sper-*

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mophilus) *columbianus,* Pullman, Washington (Osborn, Kellogg and Ferris); *C. barrowensis,* Point Barrow, Alaska (Kellogg and Ferris); *C. beecheyi, beldingi* and *douglasi,* California (Kellogg and Ferris, Ferris); *C. grammurus,* Santa Catalina Mountains, Arizona (Ferris); *C. mexicanus,* Guanajuato, Mexico (Kellogg and Ferris); *C. oregonus,* Pine Forest Mountains, Nevada (Ferris); *C. plesius ablusus,* Prince William Sound, Alaska (Ferris); *Cynomys leucurus,* Routt County, Colorado (Ferris); *Marmota* (=*Arctomys*) *flaviventer,* Burns, Oregon (Kellogg and Ferris); "western gray squirrel" (probably a species of *Citellus*), Fort Collins, Colorado (Osborn); "rock squirrel" (probably a species of *Citellus*), Boulder Canyon, Colorado (Kellogg and Ferris).

Erroneously recorded by Ferris from *Marmota flaviventer sierræ* in California. These specimens are here referred to a distinct species.

Specimens Examined. All those upon which the above records by Ferris and Kellogg and Ferris are based and the following: *Citellus eversmanni,* Altai, Siberia (U. S. N. M. 175306); *C. buxtoni,* Cichiga, northeastern Siberia (U. S. N. M. 199576); *C. elegans,* Colorado Springs, Colorado; *C. osgoodi,* Circle, Alaska (U. S. N. M. 128369); *Callospermophilus castanurus,* Park City, Utah (U. S. N. M.).

The hosts are all *Sciurids,* "ground squirrels" (*Citellus*), "prairie dogs" (*Cynomys*) and "marmots" or "wood chucks" (*Marmota*). Ferris (1916) has translated Osborn's "western gray squirrel" into *Sciurus cinereus* but there is no warrant for this.

Female (Fig. 170). A stout bodied species. Length 1.6–1.7 mm. *Head* acutely rounded in front with the antennæ set well back from the apex; with the post-antennal angles rounded and not prominent, with a slightly constricted occipital region and with the lateral margins of the hind head straight and nearly parallel. Ventral side of the head without a raised gular region. Antennæ without a modified seta on the first segment. *Thorax* about as long as the head; sternal plate (Fig. 171*B*) roughly oval, wider than long, with a slight median, posterior point.

Pleural plates (Fig. 171*A*) as follows: plates of the first segment lacking; plates of the second segment small, each posterior angle produced into a small lobe, the posterior margin with a pair of small setæ; plates of the third to sixth segments irregular in form, with each posterior angle produced into a bluntly rounded point and with two or three slender setæ (the number varying even in a single specimen); plates of the seventh and eighth segments very small, bearing the usual long setæ.

Tergal and sternal plates of the abdomen entirely lacking except for the genital plate, the ninth tergite and faint vestiges on the second tergite. Rows of setæ arranged in the normal manner, for the most part extending entirely across the abdomen, including as many as thirty setæ, these

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slender except for a few on the ventral side near the lateral margins of the third to sixth segments which are sometimes more or less enlarged.

MALE (Fig. 170). Length 1.1–1.3 mm. *Antennæ* with the third segment not at all modified.

Tergal and sternal plates of the abdomen very narrow, the sternal

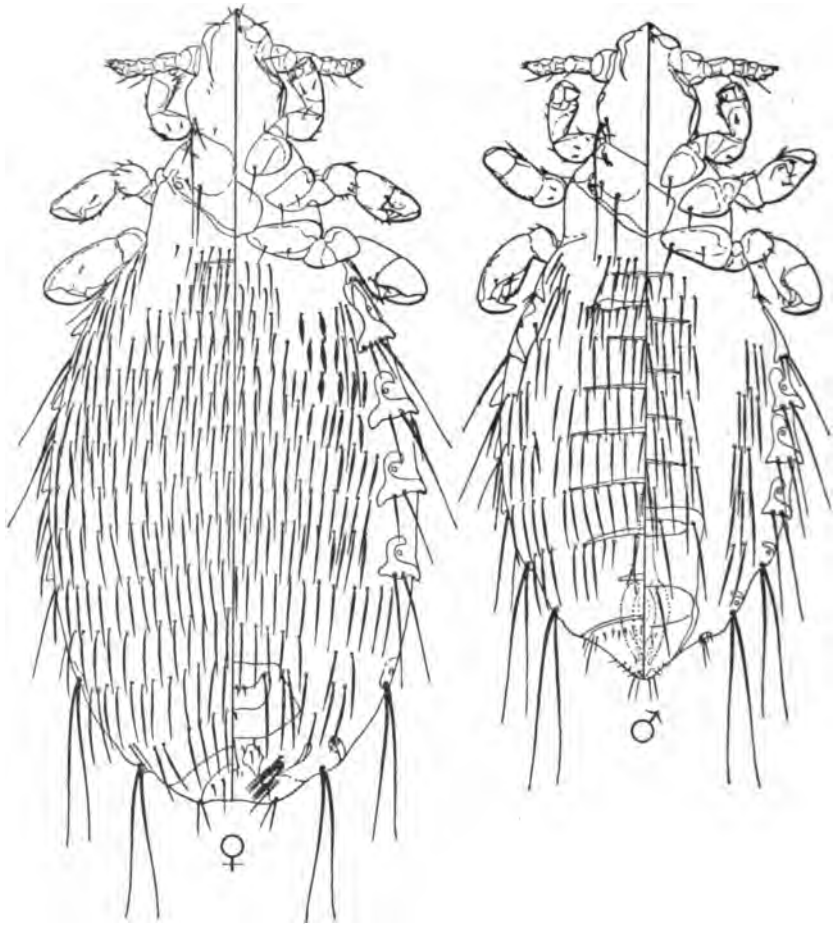

Fig. 170.—*Neohæmatopinus læviusculus* (Grube), male and female, from specimens from *Citellus eversmanni*.

plates present only in connection with the anterior row of setæ on each segment. Second plate of the second tergite slightly but definitely emarginate. Rows of setæ distributed in the normal manner, arranged, both dorsally and ventrally, in median and lateral groups. Dorsal median groups with for the most part fifteen or sixteen setæ, the lateral groups

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with three or four. Ventral median groups with four or five setæ, the lateral groups with three or four.

Genitalia (Fig. 171*D*) with the basal plate (*bp*) short and rather broad; parameres nearly as long as the basal plate, heavy, tapering, and nearly parallel, enclosing a slender, V-shaped endomeral piece (*e*), the penis (*p*) and the pseudopenis (*pp*). The last is broadly V-shaped, with the arms expanded and serrate externally.

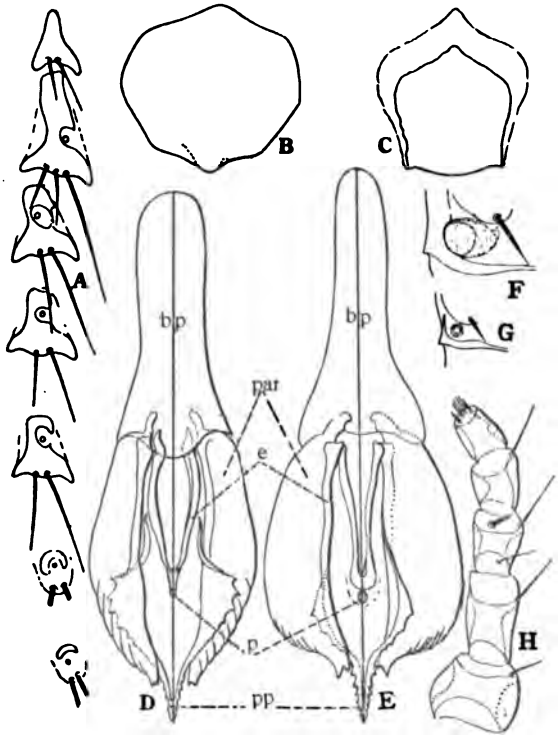

Fig. 171.—*Neohæmatopinus læviusculus* (Grube): *A*, pleural plates; *B*, sternal plate; *D*, genitalia of male; *G*, thoracic spiracle; from specimens from *Citellus eversmanni*. *Neohæmatopinus marmotæ* n. sp.: *C*, sternal plate; *E*, genitalia of male; *G*, thoracic spiracle; *H*, antenna of male.

NOTES.—I feel no doubt in placing all the specimens above listed under a single species for there is surprisingly little variation in spite of the wide geographical range. In some specimens the majority of the pleural plates bear three setæ instead of two but this character is not at all constant, even as between the two sides of the same individual. On the other hand, specimens from *Marmota* that I have previously referred to this species seem really to be distinct.

Fahrenholz (1916) has referred the *Pediculus læviusculus* of Grube to *Enderleinellus* and if this view were accepted the name *montanus* should be used for the

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species here dealt with. However, I can not concur in Fahrenholz's view. The original description and figures of *læviusculus* are poor but they seem sufficiently definite to establish with reasonable certainty the application of the name to the species here considered.

14. Neohæmatopinus marmotæ n. sp.

FIGS. 171*C*, 171*E*, 171*F*.

1916. *Linognathoides montanus* (Osborn), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 159 (part; misidentification).

1916. *Linognathoides montanus* (Osborn), Ferris, *Psyche* **23**: 99 (part; misidentification).

PREVIOUS RECORDS. From *Marmota flaviventer* (=*flaviventris*) *sierræ*, Yosemite National Park, California.

SPECIMENS EXAMINED. The types (holotype a male) from the above. Also from "ground hog," *Marmota* sp., Florence, Montana (F. C. Bishop). A single male from *Marmota aurea*, Tagdumdash, Pamir, Asia (U. S. N. M. 62116) is doubtfully referred here.

FEMALE. Length 2.3 mm. In general quite closely resembling *N. læviusculus* but differing notably in its much larger size, heavier chitinization of all the parts, in having the sternal plate of the thorax (Fig. 171*C*) quite differently shaped and more weakly chitinized and in having the thoracic spiracles (Fig. 171*F*) strikingly large, these spiracles in *læviusculus* being very small (Fig. 171*G*).

MALE. Length 1.7 mm. Differing in the same respects as does the female. With the third segment of the antennæ (Fig. 171*H*) slightly modified and bearing a single stout seta. With the genitalia (Fig. 171*E*) slightly different, the parameres (*par*) being heavier and tapering sharply near the tips instead of tapering gradually, the pseudopenis (*pp*) with the arms less expanded.

NOTES.—This seems to be sufficiently distinct from *N. læviusculus* to merit full specific standing. The specimen from *Marmota aurea* is evidently quite close to this but is not in good condition and is referred here only tentatively.

15. Neohæmatopinus pectinifer (Neumann).

FIG. 172.

1885. *Hæmatopinus setosus* Piaget, "Les Pediculines," Supplement, p. 143; pl. 15, f. 6 (not of Burmeister).

1908. *Hæmatopinus setosus* (Piaget), Dalla Torre, "Anoplura," *Gen. Ins.* p. 11.

1909. *Hæmatopinus* (*Polyplax*) *pectinifer* Neumann, *Arch. de Parasit.* **13**: 528–9; f. 28–9.

1914. *Linognathoides setosus* (Piaget), Cummings, *Bull. Ent. Res.* **5**: 160.

1916. *Linognathoides pectinifer* (Neum.), Ferris, "Cat. Anoplura," *Proc. Cal. Acad. Sci.* (4) **6**: 159.

1916. *Lutegus pectinifer* (Neum.), Fahrenholz, *Archiv. f. Naturges.* **81**, 11: 31.

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PREVIOUS RECORDS. From *Xerus getulus,* without indication of locality (Piaget) and from "squirrel," without indication of locality (Neumann). The type host is a native of northern Africa.

SPECIMENS EXAMINED. A single male from the material recorded by Neumann, received through the kindness of Professor A. Martin of the Ecole Veterinaire de Toulouse.

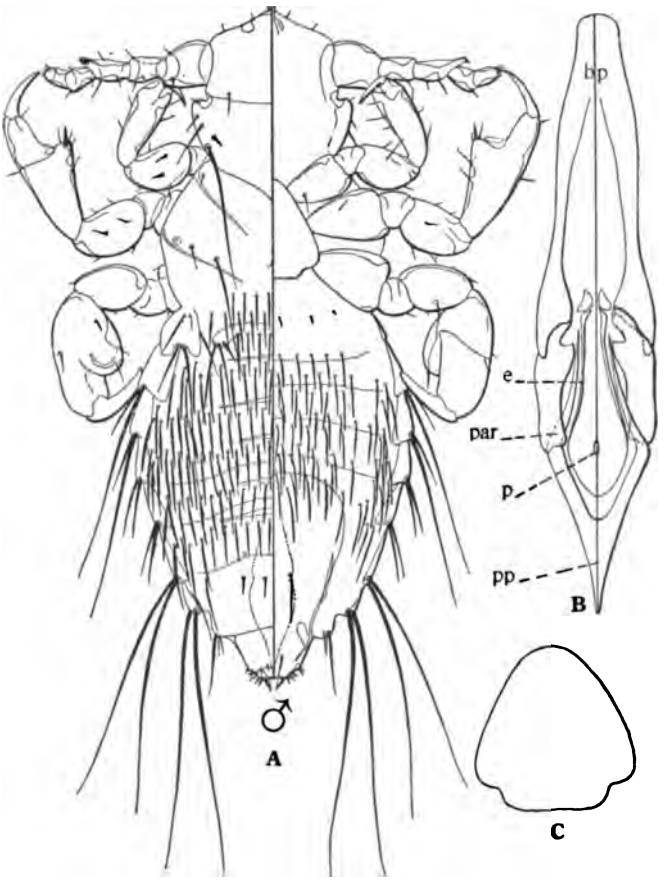

Fig. 172.—*Neohæmatopinus pectinifer* (Neumann): *A,* male; *B,* genitalia of male; *C,* sternal plate.

MALE (Fig. 172*A*). Length 1.3 mm. *Head* as broad as long, slightly pointed in front, with the antennæ set close to the anterior margin; with prominent, acute post-antennal angles, without a constricted occipital region, the lateral margins of the hind head convex and quite strongly convergent. Ventral side without a raised gular region. Antennæ relatively very long, the first segment noticeably enlarged but without a

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modified seta, the third segment modified and bearing a stout, recurved seta at the apex.

Thorax about as long as the head and with the lateral margins strongly convex; sternal plate (Fig. 172*C*) triangular, with rounded angles and with the apex anteriorly; legs large and stout.

Pleural plates as follows: first pair apparently obsolete, their position marked by a pair of small setæ; second with each posterior angle produced into a small, rounded lobe and bearing a pair of slender setæ; plates of the third to seventh segments without a tooth at the posterior angles or at the most with this very small, the plates of the third and fourth segments with the dorsal seta very long, the ventral seta about as long as the plate, the plates of the seventh and eighth segments with the usual long setæ.

Tergal plates very small and slender, the second plate of the second segment very distinctly emarginate. *Sternal plates* apparently entirely obsolete. Rows of setæ arranged in the normal manner, continuous across the abdomen, containing as many as twenty to thirty setæ.

Genitalia (Fig. 172*B*) with the basal plate (*bp*) quite broad, almost completely divided into two longitudinal pieces; parameres (*par*) very short and stout, nearly parallel, enclosing a slender, loop-shaped endomeral piece (*e*) and the penis (*p*); pseudopenis (*pp*) relatively very large, V-shaped, nearly twice as long as the parameres, with the arms convergent anteriorly. Tip of the abdomen beset with short, stout setæ.

FEMALE. The description given by Piaget is inadequate to afford a definite picture of the female.

NOTES.—Fahrenholz, merely on the basis of the published descriptions of this species, has made it the type of the genus *Lutegus*. I am unable to see any reason for this genus. At the best it cannot be separated from *Linognathoides*, even if the latter be regarded as distinct from *Neohæmatopinus*. The form of the head and the character of the genitalia are its most distinctive features.

The single specimen that I have examined was not in the best of condition for study and it is possible that some details of the accompanying figures may not be entirely exact.

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Contributions Toward a Monograph of the Sucking Lice

PART V

By

GORDON FLOYD FERRIS

Associate Professor of Zoölogy

STANFORD UNIVERSITY PRESS
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PREFATORY NOTE

The long delay since the appearance of the fourth paper in this series has been due to various causes, among which the press of other interests has not been unimportant. However, this delay has not been without a decided gain. As was stated in the first paper of the series, the treatment of the various groups has been dictated by the availability of material, those genera of which the greatest representation of species could be secured being considered first. Scientifically unjustifiable as such a procedure may be, the advantages have been many, but the end of this readily available material had been reached with the publication of Part IV, and it was necessary either to present the further contributions in incomplete form or to wait until opportunity offered for more thorough treatment.

That opportunity fortunately came, and the author was able to spend some months of concentrated work at the Molteno Institute for Research in Parasitology at Cambridge University. A full statement of all obligations will be presented in the final part of this series, but it is imperative that due acknowledgment be made here of the courtesies that have made possible the completion of this section. To Professor G. H. F. Nuttall, of the Molteno Institute, I desire to express the most sincere appreciation for his kindness and his assistance, not only in placing at my disposal the facilities of the Molteno Institute, but for aiding in securing help from other sources. To Major E. E. Austen of the British Museum of Natural History is due acknowledgment for placing at my disposal the Anoplura collections of that institution, these including the invaluable Piaget Collection. Dr. Titschack of the Hamburg Museum loaned the entire Anoplura collection of that Museum, including many of the types of Fahrenholz and other important material. Dr. Günther Enderlein of the Berlin Museum also loaned certain species of importance. And to Mr. G. A. H. Bedford and Mr. Lawrence Hill of South Africa are due special acknowledgments for their kindness in sending me material that otherwise could not have been seen. It is only because of the aid of these various institutions and individuals that anything resembling completeness in the concluding parts of this work has been possible. As it is, a final summary will show that but few known species of the sucking lice have not been available to the writer for examination. The hope expressed in the first paper that the series might in the end be truly monographic has been realized, and the last portion of the series now awaits merely the opportunity for publication.

Following the precedent set by the earlier parts of this work, the genera

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still to be dealt with will be treated in an order governed entirely by convenience. In the case of some of the genera already dealt with, additional information has come to hand, or treatment by other authors has necessitated further consideration herein. The present paper is devoted chiefly to the presentation of such additional information and to the consideration of a number of small genera and of the larger genus *Linognathus*.

G. F. F.

STANFORD UNIVERSITY, CALIFORNIA
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SYSTEMATIC TREATMENT (Cont.)

ON CERTAIN RECENT GENERIC SEGREGATES FROM THE GENERA *ENDERLEINELLUS, HOPLOPLEURA, POLYPLAX,* AND *NEOHAEMATOPINUS*

Since the appearance of the parts of this monograph dealing with the genera *Enderleinellus, Hoplopleura, Neohaematopinus,* and *Polyplax,* there has appeared a work in which a number of new genera have been named as segregates from these, based for the most part upon species described by the present writer. The writer has elsewhere expressed his opinion of this work and it need not here be repeated. A review of these genera, however, must appear somewhere in the present series of papers in order to present a complete picture of the status of our knowledge of the Order, and the present time is perhaps as propitious as any. The genera in question may be reviewed conveniently as a group.

SEGREGATES FROM THE GENUS *ENDERLEINELLUS*

The genus *Enderleinellus,* which was dealt with in the first paper of this series, is almost an ideal expression of the writer's concept of a genus. It is a very homogeneous group of species, all obviously quite closely related, all agreeing in the possession of certain distinctive characters except for an occasional departure from the type that does not at all obscure the fundamental thread of unity, all from related hosts, and thus evidently forming a biologically significant group. Within the genus are to be detected certain quite clearly recognizable sub-groups and there are a certain number of species that in the present state of our knowledge stand more or less by themselves. With an increase of our knowledge it may eventually be possible to trace the group connections more closely, and if the number of included species be greatly increased some division might eventually be justified. But, in the present state of our knowledge, the wrenching off of bits of the structure to form new genera, especially without any attempt at a general reorganization in the light of increased knowledge, seems to the writer forced and undesirable. While certain species may upon one plausible pretext or another be removed, others must remain, thus leaving to the parent genus a meaningless aggregation of odds and ends. In the opinion of the writer, the following names should not be recognized at the most as designating anything more than possible subgeneric groups:

Genus HOPLOPHTHIRUS Ewing

1929. Ewing, *Manual of External Parasites,* pp. 194, 133.

TYPE. *Enderleinellus euxeri* Ferris. The only included species.

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Genus CYCLOPHTHIRUS Ewing

1929. Ewing, *Manual of External Parasites,* pp. 195, 133.

TYPE. *Enderleinellus suturalis* (Osborn). *E. marmotae* Ferris, *E. osborni* Kellogg and Ferris, and "probably *E. tamiasis* Fahrenholz," also included.

NOTE.—With the exception of *E. tamiasis* Fahrenholz, the species included in this group form a natural assemblage within the genus *Enderleinellus.*

Genus RHINOPHTHIRUS Ewing

1929. Ewing, *Manual of External Parasites,* pp. 196, 133.

TYPE. *Enderleinellus heliosciuri* Ferris. The only included species.

Genus EUENDERLEINELLUS Ewing

1929. Ewing, *Manual of External Parasites,* pp. 197, 133.

TYPE. *Enderleinellus larisci* Ferris. *E. menetensis* Ferris, *E. platyspicatus* Ferris, *E. zonatus* Ferris were also included.

NOTES.—The present writer is quite unable to follow the reasoning which places the foregoing list of species as especially closely related to each other to the exclusion of others in the genus *Enderleinellus.* In his opinion the genus is simply meaningless.

SEGREGATES FROM THE GENUS *HOPLOPLEURA*

As pointed out by the writer in the earlier treatment of this genus, it contains some discordant forms, species which are obviously of this generic type but which depart so widely that they will probably need to be separated from *Hoplopleura* as our knowledge increases. Four genera have been thus removed, but of them only two appear to have any real justification.

Genus PTEROPHTHIRUS Ewing

1923. *Pterophthirus* Ewing, *Journal of the Washington Academy of Sciences,* 13: 147.

1929. *Pterophthirus,* Ewing, *Manual of External Parasites,* p. 135.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; with the anterior legs small and weak and with slender claw, the middle legs somewhat larger and with stouter claw, the posterior legs still larger, more or less flattened, with stout claw and with a small, tubercle-like process at the outer, basal angle of the tibia; paratergal plates strongly developed, present on the first to eighth segment, those

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of the second segment greatly enlarged, elongate and flattened, and extending wing-like from the side of the body, those of the first segment small and lying upon the dorsum; female with three plates and three transverse rows of setae upon the majority of abdominal segments, both dorsally and ventrally; male with one row of setae dorsally and two rows ventrally on the majority of the abdominal segments; sternites of the first and second abdominal segments, in both sexes, extending across the venter from paratergite to paratergite, that of the second segment without a pair of stout setae at each side.

HOSTS. From South American rodents of the family Octodontidae.

TYPE OF THE GENUS. *Hoplopleura alata* Ferris.

SYNONYMICAL LIST OF NAMES INCLUDED IN THE GENUS

NOTE.—Names in italics are synonyms of the name with which they are coupled.

alata (Ferris).
Hoplopleura alata Ferris.
audax (Ferris).
Hoplopleura audax Ferris.

NOTES.—Following upon the suggestion made by the writer in connection with the original description of the species here included, Ewing has based this genus upon them. In the writer's opinion their removal from *Hoplopleura* should not have been undertaken except in connection with a revision of the entire genus upon the basis of a knowledge much greater than that which we now possess, since there are other species that might well come out of *Hoplopleura* but which are still left within it, thus making our generic concepts very uneven.

However, the action having been taken, and these two species probably in fact representing the nucleus of a natural group, the genus may be accepted. Its included species, having been described and figured in this series, need be considered no further than to present their bibliography and synonymy.

1. Pterophthirus alata (Ferris)

1921. *Hoplopleura alata* Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, University Series, Biological Sciences, 2: 2: 127–128; figs. 84, 85.

1923. *Pterophthirus alata* (Ferris), Ewing, *Journal of the Washington Academy of Sciences,* 13: 147.

2. Pterophthirus audax (Ferris)

1921. *Hoplopleura audax* Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, University Series, Biological Sciences, 2: 2: 125–127; figs. 82, 83.

1923. *Pterophthirus audax* (Ferris), Ewing, *Journal of the Washington Academy of Sciences,* 13: 148.

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Genus CTENURA Ewing

1929. Ewing, *Manual of External Parasites*, pp. 199, 135.

TYPE. *Hoplopleura pectinata* Cummings. The only included species.

NOTE.—While this species is an extreme and unusual member of the genus *Hoplopleura*, the writer cannot subscribe to the view that its removal from that genus is called for.

Genus EUHOPLOPLEURA Ewing

1929. EWING, *Manual of External Parasites*, pp. 199, 133.

TYPE. *Hoplopleura trispinosa* Kellogg and Ferris. The only included species.

NOTE.—While this species offers certain specific peculiarities that may be seized upon for its isolation, its relationships seem to the writer to be so obviously with such forms as *H. maniculata* (Neumann), *H. erratica* (Osborn), and *H. sciuricola* Ferris, for example, that to separate these species generically is merely to obscure the facts of relationship.

Genus CTENOPLEURA Ewing

1929. Ewing, *Manual of External Parasites*, pp. 200, 135.

TYPE. *Hoplopleura cryptica* Ferris. The only included species.

NOTES.—This species is very obviously related to certain others, such as *H. vepsecula* Ferris, *H. neumanni* Fahrenholz, and *H. biseriata* Ferris, which constitute a minor group in the genus *Hoplopleura* but which were left behind in the naming of the new genus. Whatever is done with them, they should at least remain together. The writer sees no adequate reason for removing them from *Hoplopleura*.

Genus FERRISELLA Ewing

1929. Ewing, *Manual of External Parasites*, pp. 198, 135.

TYPE. *Hoplopleura ochotonae* Ferris. In addition, *H. disgrega* Ferris, *H. malaysiana* Ferris, and *H. emarginata* Ferris were referred to this genus.

NOTE.—While *Hoplopleura ochotonae* Ferris is a somewhat isolated species, it does not seem to the writer to call for separation from *Hoplopleura*, and to link it with such species as those included with it in *Ferrisella* requires the utilization of characters which seem to have no phylogenetic significance and results in the production of a highly artificial and meaningless group.

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SEGREGATES FROM GENERA *POLYPLAX* AND *NEOHAEMATOPINUS*

Genus AHAEMATOPINUS Ewing

1929. Ewing, *Manual of External Parasites*, pp. 197, 134.

TYPE. *Neohaematopinus inornatus* Kellogg and Ferris. *Polyplax insulsa* Ferris and *P. oxyrrhynchus* Cummings were also included.

NOTES.—While the limits of the genera *Polyplax* and *Neohaematopinus* and the definitions of these genera are somewhat unsatisfactory, the writer can see no clarification of our understanding by the linking together of the three species named above. In his opinion they have nothing to do with each other, having merely been grouped together by seizing upon an artificial aggregation of characters. The genus is meaningless and should be sunk as a straight synonym of *Neohaematopinus*.

TWO GENERA ERRONEOUSLY REFERRED TO THE ANOPLURA

Genus ACANTHOPHTHIRIUS Perkins

1925. Perkins, *Annals and Magazine of Natural History*, (9), 16: 175.

The writer has examined the types of *Acanthophthirius etheldredae* Perkins, which are in the collections of the Molteno Institute. It is an immature mite and need not further be considered in connection with the Anoplura.

Genus HAEMATOMYZUS Piaget

1931. Ferris, *Parasitology*, 23: 112–127; t. figs. 1–5; pls. 4, 5.

This genus has long stood as a member of the Anoplura, but as the writer has shown, it does not belong to this group. It has been placed by him as a sub-order, the Rhynchophthirina, of the Mallophaga.

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Genus **HOPLOPLEURA** (Cont.)

Hoplopleura acanthopus (Burm.) (Cont.)

1921. *Hoplopleura acanthopus* (Burmeister), Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, University Series, Biological Sciences, 2: 63.
1921. *Hoplopleura acanthopus aequidentis* Fahrenholz, Ferris, *ibid.,* p. 67.
1921. *Hoplopleura acanthopus edentulus* Fahrenholz, Ferris, *ibid.,* p. 67.

NOTES.—Through the kindness of the Berlin Museum the writer has had the privilege of examining the types of *Hoplopleura acanthopus aequidentis* Fahrenholz and specimens evidently from the type lot of *H. acanthopus edentulus* Fahrenholz. The former agree exactly with what the writer takes to be typical *Hoplopleura acanthopus,* and the latter depart only in having the dorsal process of the third paratergal plate quite broad but differing no more from the typical form than by what may be regarded as within the normal range of variation.

There seems to be no good reason for recognizing either of these forms and they may be sunk into the synonymy of *Hoplopleura acanthopus.*

Genus **SCIPIO** Cummings (Cont.)

1922. *Scipio,* Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, University Series, Biological Sciences, 2: 170.
1929. *Scipio,* Ewing, *Manual of External Parasites,* p. 133.

Since the publication of Part III of this series of papers there has come to hand an undescribed species the affinities of which are clearly with the two genera, *Scipio* and *Hybophthirus,* therein dealt with. The three species now included in these two genera agree in the common possession of a claw-like process arising from the apex of the morphologically posterior side of the anterior tarsus alongside of the true claw. It has been pointed out by the writer that this structure is not a claw, but a more recent author (Ewing, 1929) has continued the error of calling it such. The matter will be dealt with at length in the morphological section which will constitute one of the final portions of this series and need not be considered further here.

The new species is evidently most closely affiliated with the genus *Scipio,* although a considerable expansion of the definition of this genus will be necessary to permit its inclusion therein. The writer, however, is opposed in principle to the naming of new genera except in those cases where there results a definite advance in the clarification of our knowledge. Such does not seem to be the case here.

The definition of the genus *Scipio* may therefore be enlarged as follows: second and third legs subequal and with stout, heavy claw or the second pair of this nature and the third pair smaller and with slender

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claw; paratergal[1] plates present on the third to seventh or third to eighth segments.

Scipio tripedatus n. sp.

FIGS. 173, 174, 175

SPECIMENS EXAMINED. The holotype, a female, and a single immature specimen from "nokey," without indication of locality nearer than South

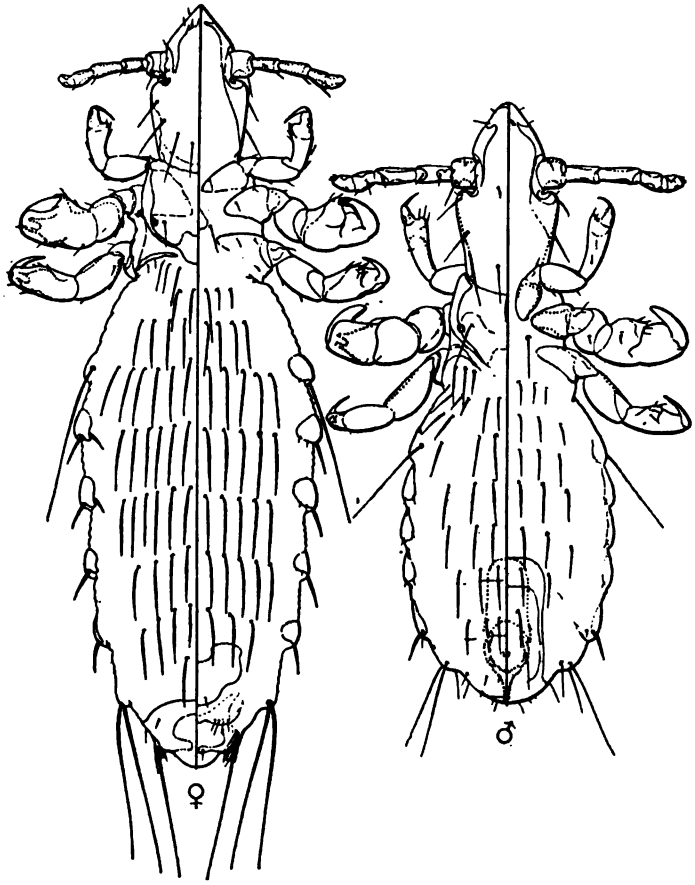

FIG. 173.—*Scipio tripedatus* n. sp., male and female.

Africa, and the allotype, from *Petromys typicus tropicalis,* Windhoek, Southwest Africa, all received from G. A. H. Bedford and the holotype

[1] Following the conclusions of Snodgrass, the abdominal plates called "pleurites" in earlier papers of this series will hereafter be called "paratergites."

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returned to him. Bedford states that he has taken other specimens from the same species of *Petromys*.

FEMALE (Fig. 173). Length 1.5 mm. *Head* relatively very large, about twice as long as wide and very closely resembling the head of *Scipio aulacodi* (Neumann); antennae (Fig. 174 *E*) slender, relatively very large.

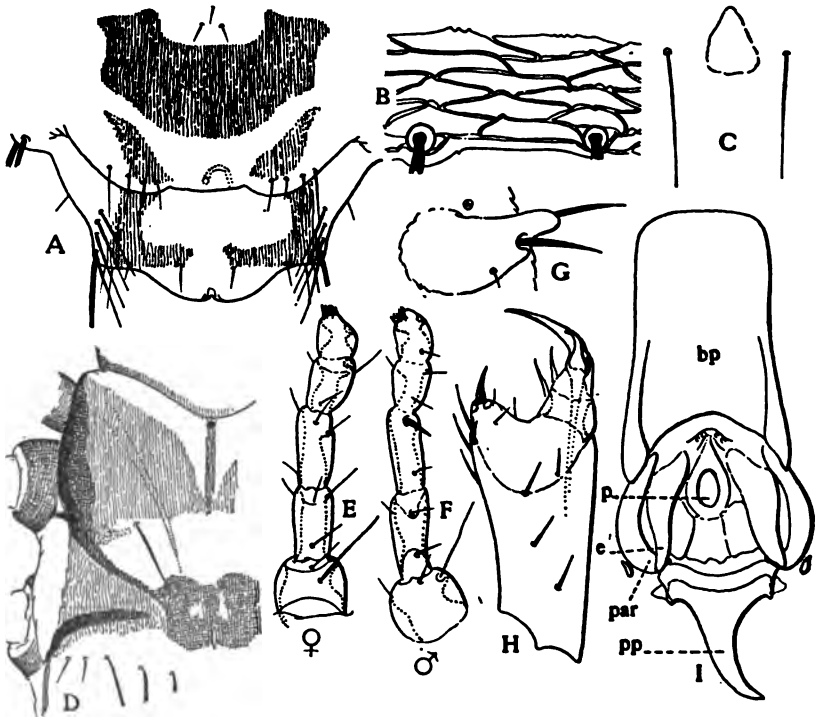

FIG. 174.—*Scipio tripedatus* n. sp.: *A*, genital region of female; *B*, portion of derm of abdomen; *C*, sternal plate of thorax; *D*, dorsum of thorax; *E*, antenna of female; *F*, antenna of male; *G*, paratergal plate of nymph; *H*, anterior tibia and tarsus; *I*, genitalia of male.

Thorax (Fig. 174 *D*) slightly shorter than the head and but little wider, its lateral margins nearly parallel, the dorsum with the notum entirely obliterated, the pleurites connecting across the meson. *Sternal plate* (Fig. 174 *C*) very small and inconspicuous, flanked by a pair of setae. *Legs* of most unusual character, the second pair being much larger than either of the others; first pair (Fig. 174 *H*) small, of the type common to the genus; second pair large and stout, with stout claw; third pair intermediate between the first and second and with rather slender claw.

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Abdomen membranous except the median region both dorsally and ventrally faintly sclerotic; derm (Fig. 174 *B*) reticulate; each segment, both dorsally and ventrally with but a single row of quite long, slender setae. *Paratergal plates* present on the third to seventh segments, small, their exact form indeterminable in the specimen at hand, those of the third segment accompanied by a long dorsal seta, those of the other segments each armed with a pair of stout, thorn-like setae. Genital region as shown in Fig. 174 *A*, the gonopophyses practically obsolete.

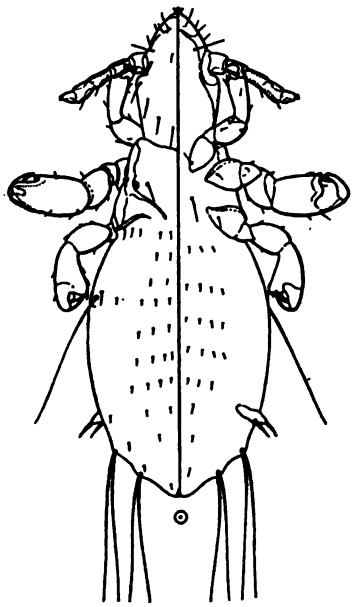

FIG. 175.—*Scipio tripedatus* n. sp., nymph.

MALE (Fig. 173). Length 1 mm. In general appearance quite closely resembling the female. *Antennae* (Fig. 174 *F*) with the third segment slightly modified, bearing a single short, stout seta near its apex on the dorsal side. *Paratergal plates* lacking the large setae found in the female. *Genitalia* (Fig. 174 *I*) with a short, broad basal plate (*bp*), short, strongly curved parameres (*par*), a very stout T-shaped pseudopenis (*pp*) articulating with the ends of the parameres, a pair of somewhat wedge-shaped endomeral pieces (*e*) and between them the large opening of the penis (*p*) surrounded by a ring which seems to be continuous with a somewhat vague median plate.

IMMATURE STAGE (Fig. 175). A single specimen representing an undeterminable instar is at hand. It is in general form very similar to the

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adult. The abdominal setae, however, are very minute and paratergal plates are present on but the third and seventh segments, the latter (Fig. 174 *G*) projecting tooth-like from the body and armed with two stout setae.

NOTES.—Possibly this species should be referred to a new genus, but in spite of its peculiarities its relationships are obviously with *Scipio*.

Genus **ENDERLEINELLUS** Fahrenholz (Cont.)

One species which was not available at the time of the treatment of this genus has since been seen and is here dealt with.

Enderleinellus tamiasis Fahrenholz

FIG. 176

1916. ***Enderleinellus tamiasis*** Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, 81: 11: *27–29*; t. fig. *22*.

PREVIOUS RECORDS. Known only from the original description, from

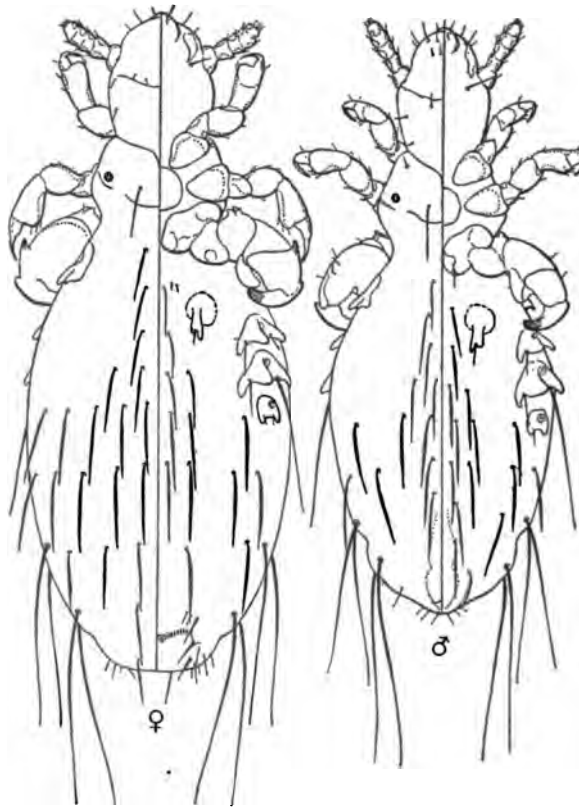

FIG. 176.—***Enderleinellus tamiasis*** Fahrenholz, male and female. From the types.

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Tamias striatus, Berlin Zoölogical Gardens. The host is a native of eastern North America.

SPECIMENS EXAMINED. A male and a female from the type lot, received as a loan through the kindness of Dr. G. Enderlein of the Berlin Museum.

NOTES.—The specimens examined are not good preparations, being uncleared, and do not permit careful study, it being impossible to figure the genitalia of the male or to determine the presence or absence of sclerotic tergal and sternal plates. Of the known species it seems to approach most closely *E. malaysianus* Ferris, which it rather closely resembles in general form and in the number of the paratergal plates. It differs, however, especially in having the spiracles quite small. The genitalia of the male are so small and so obscured by the body tissues that it is impossible to do more than note their general features. They appear to be most similar to those of *E. larisci* Ferris, the parameres being of the same form, the pseudopenis larger and more V-shaped, the penis apparently being an elongate tube which is inclosed between the bases of the arms of the pseudopenis. Length, as given by Fahrenholz, of female .636–.735 and of male .638–.675 mm.

The types having been taken in a zoölogical garden, there is the possibility that the species is not normal to *Tamias striatus.*

Genus **HAEMATOPINOIDES** Osborn

1891. *Haematopinoides,* Osborn, *United States Department of Agriculture, Division of Entomology Bulletin* (old series), **7**: 28.
1896. *Haematopinoides,* Osborn, *ibid., Bulletin* (new series), **5**: 187.
1896. *Euhaematopinus,* Osborn, *ibid., Bulletin* (new series), **5**: 186.
1904. *Haematopinoides,* Enderlein, *Zoologischer Anzeiger,* **28**: 136, 140.
1904. *Euhaematopinus,* Enderlein, *ibid.,* **28**: 136, 140.
1908. *Haematopinoides,* Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum,* p. 15.
1908. *Euhaematopinus,* Dalla Torre, *ibid.,* p. 16.
1915. *Haematopinoides,* Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 46.
1915. *Euhaematopinus,* Kellogg and Ferris, *ibid.,* p. 46.
1916. *Euhaematopinus,* Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 179.
1916. *Haematopinoides,* Ferris, *ibid.,* p. 180.
1922. *Euhaematopinus,* Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, Biological Sciences, **2**: 3: 148–149.
1929. *Haematopinoides,* Ewing, *Manual of External Parasites,* pp. 140–141.

NOTES.—It was pointed out by Kellogg and Ferris (1915) and by Ferris (1922) that the genus *Euhaematopinus* is in all probability a synonym of *Haematopinoides.* Ewing (1929) reports the discovery of the type specimens of *H. squamosus* Osborn, which were supposed to have been lost, and confirms this opinion. The genus having already been considered in this series under the name of *Euhaematopinus,* it need not be treated here further than to present its bibliography and make the necessary change in the name of the type.

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TYPE OF THE GENUS. *Haematopinoides squamosus* Osborn.

Haematopinoides squamosus Osborn

1891. *Haematopinoides squamosus* Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (old series), **7**: 28; fig. 16.
1896. *Haematopinoides squamosus* Osborn, *ibid., Bulletin* (new series), **5**: 187; fig.
1896. *Euhaematopinus abnormis* Osborn, *ibid., Bulletin* (new series), **5**: 187.
1904. *Haematopinoides squamosus* Osborn, Enderlein, *Zoologischer Anzeiger,* **28**: 136.
1904. *Euhaematopinus abnormis* Osborn, Enderlein, *ibid.,* **28**: 140.
1908. *Haematopinoides squamosus* Osborn, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum,* p. 15; fig. 10.
1908. *Euhaematopinus abnormis* Osborn, Dalla Torre, *ibid.,* p. 16.
1915. *Haematopinoides squamosus* Osborn, Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 46.
1915. *Euhaematopinus abnormis* Osborn, Kellogg and Ferris, *ibid.,* p. 47; t. fig. 16; pl. 3, fig. 3; pl. 5, figs. 4, 9.
1916. *Haematopinoides squamosus* Osborn, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 180.
1916. *Euhaematopinus abnormis* Osborn, Ferris, *ibid.,* p. 179.
1922. *Euhaematopinus abnormis* Osborn, Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, University Series, Biological Sciences, **2**: 3: 150–153; figs. 98, 99.
1929. *Haematopinoides squamosus* Osborn, Ewing, *Manual of External Parasites,* p. 140; fig. 77.

NOTES.—The species having already been dealt with in detail in this series, it need not be considered further, other than to refute the statement by Ewing (1929) that the antennae are three-segmented. They are four-segmented, as figured by the writer.

Genus **NEOHAEMATOPINUS** Mjöberg (Cont.)

1923. Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, University Series, Biological Sciences, **2**: 4: 237.

Additional data have come to hand concerning two species of this genus which were previously dealt with, and another which was previously excluded from *Neohaematopinus* is here brought within this genus.

Neohaematopinus sciurinus Mjöberg (Cont.)

1923. *Neohaematopinus sciurinus sciurinus* Mjöberg, Ferris, *Contributions Toward a Monograph of the Sucking Lice,* Stanford University Publications, University Series, Biological Sciences, **2**: 4: 243–248; figs. 158–159.

NOTES.—The Piaget Collection, now in the possession of the British Museum, contains a single slide, including two females and one male, labeled, "*Haematopinus sphaerocephalus* Burm. sur un écureuil." These are perfectly typical specimens of *N. sciurinus.* As these specimens seem not to agree with the description given by

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Piaget for *H. sphaerocephalus* (= *Enderleinellus nitzschi* Fahr.) they may not have been the basis for his notes on the species (*Les Pediculines*) and do not necessarily require the transfer of this reference in the bibliography.

Neohaematopinus pectinifer (Neumann) (Cont.)

FIG. 177

1923. *Neohaematopinus pectinifer* (Neumann), Ferris, *Contributions Toward a Monograph of the Sucking Lice*, Stanford University Publications, University Series, Biological Sciences, 2:4:268; fig. 172.

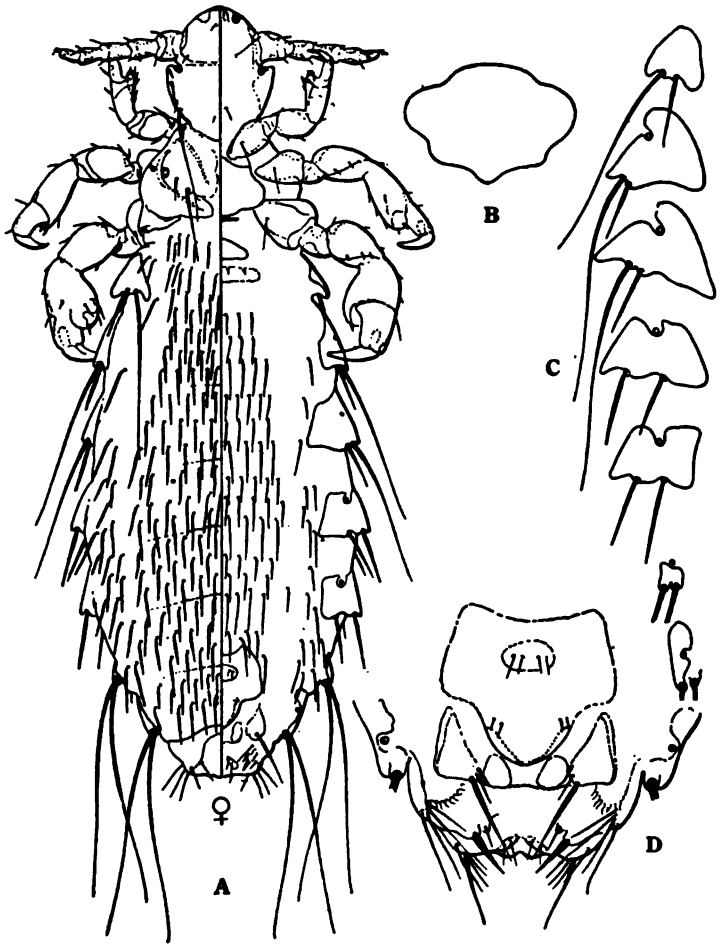

FIG. 177.—*Neohaematopinus pectinifer* (Neumann): *A*, female; *B*, sternal plate; *C*, paratergites; *D*, genital region. From the type of "*Haematopinus setosus* Piaget."

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FEMALE (Fig. 177 *A*). Length 2 mm. In form of head and thorax agreeing with the male as previously described and figured in this series, except that the sternal plate (Fig. 177 *B*) is much shorter and broader.

Paratergal plates (Fig. 177 *C*) large and conspicuous, those of the second to fourth segments roughly triangular and bearing each one long and slender and one shorter seta; those of the fifth and sixth segments roughly trapezoidal and bearing each two moderately long setae; those of the seventh and eighth segments small and irregular and each with two long setae.

Tergal and sternal plates of the abdomen entirely lacking except for the usual transverse dorsal band of the ninth segment, the genital plates, and a small sternal plate on each of the first two segments. Third to seventh segments both dorsally and ventrally with three rows of setae instead of the usual two; abdominal setae numerous, short and slender. *Genital region* as shown in Fig. 177 *C*, the vagina with one of its walls strongly tessellated, the tessellations not shown in the figure.

NOTES.—The Piaget Collection contains three slides, including three females and five males, these remounted by the writer. It may be assumed that these contain the actual types of the species. The description previously given in this series included only the male and must be modified in regard to the form of the sternal plate, which, in the female, is as here figured. The examination of these specimens supports the view previously expressed by the writer that the genus *Lutegus* Fahrenholz, which was based upon this species, need not be recognized.

16. **Neohaematopinus faurei** (Bedford)

FIGS. 178, 179

1920. *Linognathoides faurei* Bedford, *Report of the Director of Veterinary Research, Union of South Africa*, 7–8: 710–712; pl. 1, fig. 2; pl. 7, fig. 3.
1927. *Linognathoides faurei* Bedford, Bedford, *ibid.*, 11–12: 738.
1929. *Linognathoides faurei* Bedford, Bedford, *Annual Report, Director of Veterinary Services, Union of South Africa*, 15: 503.

PREVIOUS RECORDS. Recorded by Bedford as a common parasite of *Geosciurus capensis* in South Africa. Type locality, Bloemfontein, Orange Free State.

SPECIMENS EXAMINED. Males and females from the type lot, received through the kindness of G. A. H. Bedford, and others from *Geosciurus capensis*, Glen, Orange Free State, received from Lawrence Hill.

FEMALE (Fig. 178). Length 2–2.15 mm. A stout-bodied species, with the head, thorax, and legs strongly sclerotic. *Head* (Fig. 179 *A*) large and broad, with the post-antennal angles prominent and with strong, lateral sclerotic area. *Thorax* broad, scarcely longer than the head, the posterior-lateral angles with small, free lobes. *Sternal plate* (Fig. 179 *D*)

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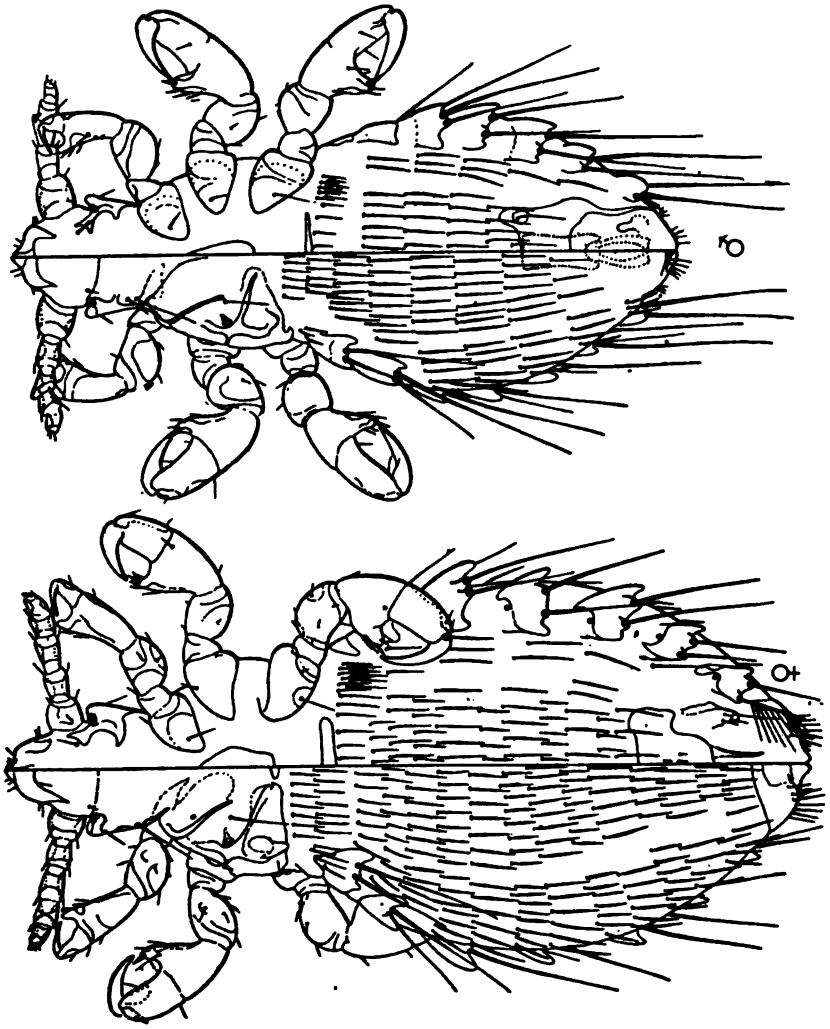

FIG. 178.—*Neohaematopinus faurei* (Bedford), male and female.

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relatively small, elongate and somewhat irregular in form. *Legs* of the type common to the genus, very large and stout.

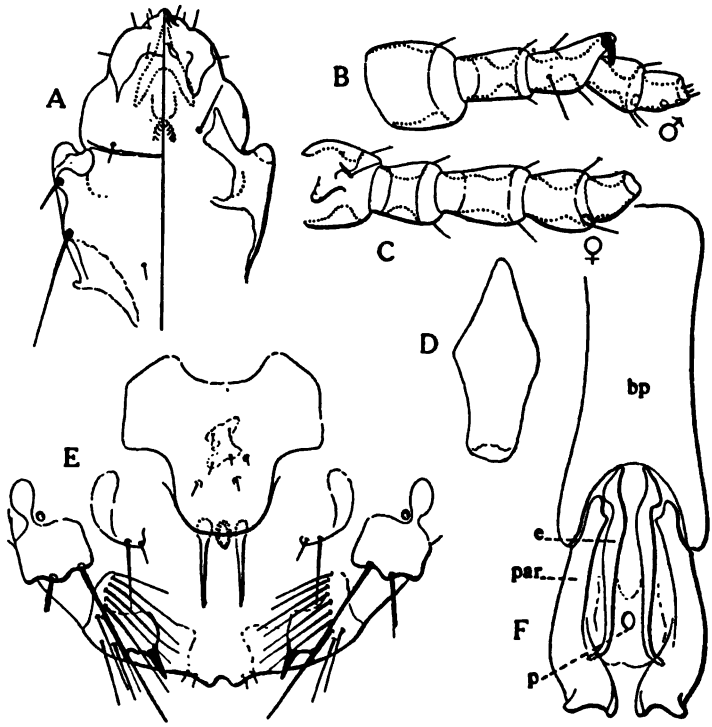

FIG. 179.—*Neohaematopinus faurei* (Bedford): *A*, head; *B*, dorsal aspect of antenna of male; *C*, ventral aspect of antenna of female; *D*, sternal plate; *E*, genital region of female; *F*, genitalia of male.

Abdomen membranous, except for the usual dorsal band on the ninth segment, the genital region, and a small first sternal plate. Setae very numerous, relatively small and slender, arranged for the most part in two rows to the segment, both dorsally and ventrally, the ventral side with a pair of clusters of setae at each side of the second segment. *Paratergal plates* very large, strongly sclerotic, and conspicuous, present on the second to eighth segments, roughly triangular or trapezoidal in shape and each bearing two long, stout setae. *Genital area* (Fig. 179 *E*) of somewhat peculiar form, the gonopophyses very small and each bearing but a couple of small setae, the genital plate of the form shown and just posterior to it a pair of slender, sclerotic points which seem to issue from the vulva; ninth segment terminating ventrally in a pair of flat lobes that are produced into a sclerotic tooth.

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MALE (Fig. 178). Length 1.75–2 mm. *Head* and thorax similar to the female, but the antennae (Fig. 179*B*) modified, the third segment with its distal pre-axial angle prolonged and bearing a stout, recurved seta on the dorsal side. *Abdomen* with but a single row of setae on each tergite and sternite, except perhaps the second tergite with two rows, and without plates except for the genital area and a small first sternite. The second tergite, while showing some irregularity in the arrangement of the setae, can hardly be said to have the characteristic form commonly found in the genus.

Genitalia (Fig. 179*F*) with a broad basal plate which is emarginate posteriorly and partially incloses the bases of the flattened and distally broadened parameres, between which lie two slender endomeral pieces. Pseudopenis apparently lacking.

NOTES.—This species was earlier set aside as not belonging to the genus *Neohaematopinus*. It is undoubtedly a very extreme member of the group, but it connects through such a form as *N. pectinifer* with the more usual type. Its relationships appear unquestionably to be with this genus and, regardless of formal definitions or technical bases for generic separation, it should be referred here.

Genus **PHTHIRPEDICULUS** Ewing

1922. *Phthirpediculus*, Ewing, *Journal of the Washington Academy of Sciences*, 13: 148.

1929. *Phthirpediculus*, Ewing, *Manual of External Parasites*, p. 143.

Anoplura without eyes; with five-segmented antennae which are sexually dimorphic, the male having the third segment armed dorsally with a pair of recurved setae; anterior legs small and weak, middle and posterior legs large and stout, with stout claw; paratergal plates present on the third to eighth segments; both sexes without sclerotic tergal and sternal plates other than the ninth tergite in the female and the genital plate in both sexes, and with but a single row of setae on each tergite and sternite; head armed with hooks and tubercles in both sexes, broad, with but slight post-antennal angles and without a constricted occipital region; thorax without the usual prothoracic pleural apophysis and without a prothoracic pleural ridge, the notum completely suppressed. Spiracles present on the third to eighth abdominal segments.

HOSTS. Known from but a single genus of the family Lemuridae.

TYPE OF THE GENUS. *Phthirpediculus propitheci* Ewing, the only included species.

NOTES.—Discussion of the relationships of genera will be presented in a later paper of this series, but we may here call attention to the amazing statement of Ewing that this genus "stands between *Pediculus* and *Phthirus*," and that "the eyes are

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present though much reduced." There is not the slightest trace of eyes, and the genus has not even a remote connection with the *Pediculus* group. The most elementary knowledge of the Anoplura should have prevented such a misleading statement. The genus is apparently related in general to the rodent-infesting Anoplura.

Phthirpediculus propitheci Ewing

FIGS. 180, 181, 182

1922. ***Phthirpediculus propitheci*** **Ewing,** ***Journal of the Washington Academy of Sciences,*** **13: 149.**

PREVIOUS RECORDS. But once recorded, from *Propithecus edwardsii,* Madagascar.

SPECIMENS EXAMINED. Numerous males and females from the type host, East Madagascar (U.S.N.M. 63351).

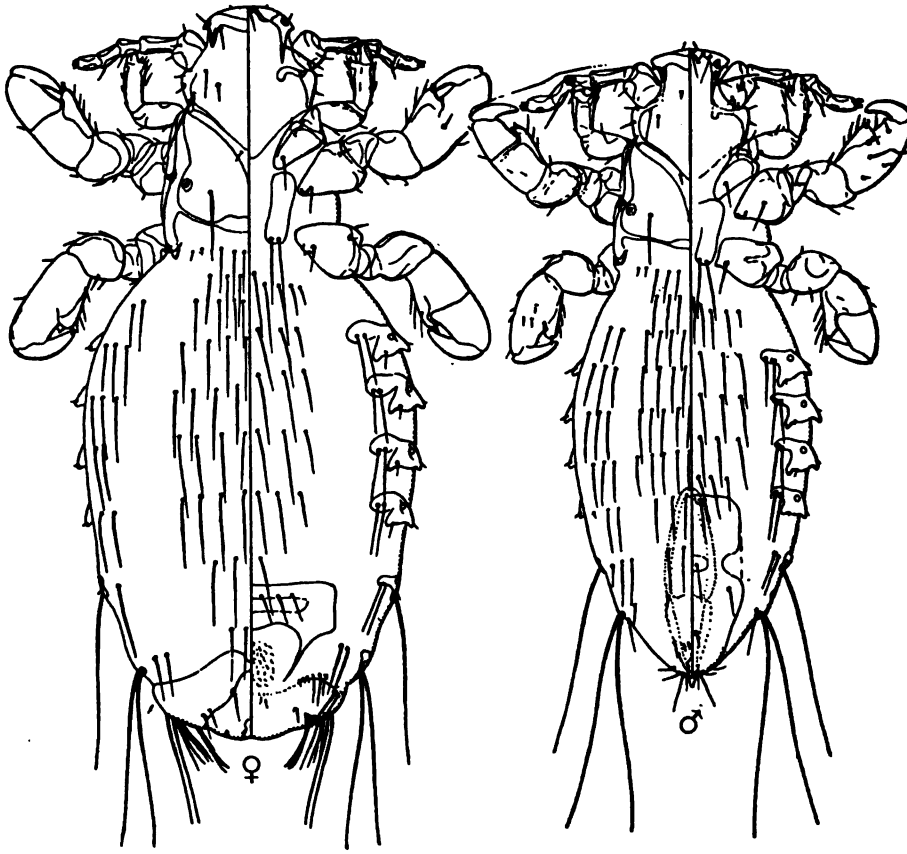

FIG. 180.—*Phthirpediculus propitheci* Ewing, male and female.

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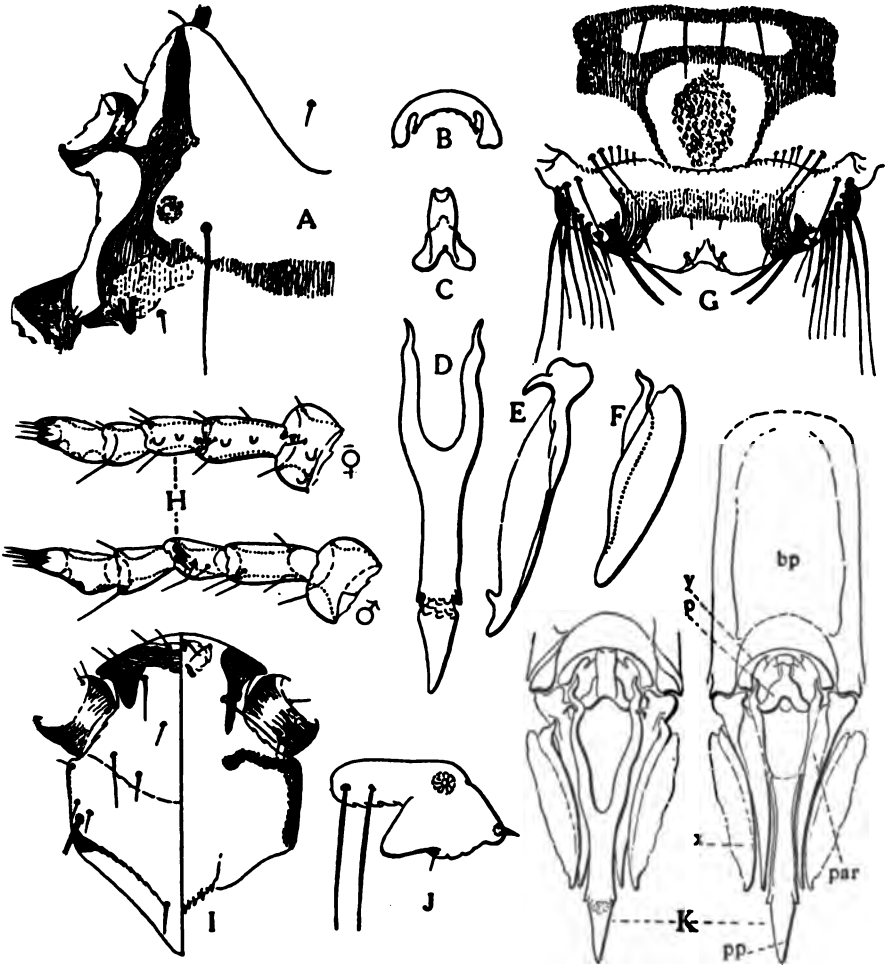

FIG. 181.—*Phthirpediculus propitheci* Ewing: *A*, dorsum of thorax; *B*, *C*, *D*, *E*, *F*, parts of the genitalia of male; *G*, genital region of female; *H*, antennae of male and female; *I*, head; *J*, paratergite; *K*, genitalia of male from dorsal (right) and ventral (left) aspects.

FEMALE (Fig. 180). Length 1.75 mm. *Head* (Fig. 191 *I*) nearly as broad as long, with the antennae set somewhat obliquely and close to the anterior margin, which is broadly rounded; fore head armed with a series of stout, sclerotic hooks and tubercles, both dorsally and ventrally. Antennae (Fig. 181 *H*) slender, the first three segments each with two or three sclerotic tubercles on the ventral side.

Thorax (Fig. 181 *A*) non-sclerotic except for the lateral band and the

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transverse meso-thoracic pleural ridge. The position of this ridge is peculiar, not being continuous with the meso-thoracic coxal condyle as is usual, but meeting the lateral band midway between the middle and third coxal condyles. The prothoracic pleural ridge and apophyses, which are normally present, are here lacking. *Sternal plate* divided longitudinally into two plates, each of which bears a pair of long setae at the posterior end. *Legs* presenting no unusual features.

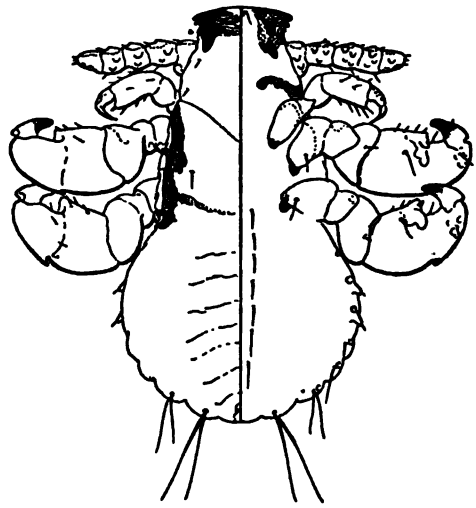

FIG. 182.—*Phthirpediculus propitheci* Ewing, nymph.

Abdomen membranous except for the ninth tergite, the genital plate and the paratergites, each segment with a single row of few, slender setae. Paratergites of the third to the sixth segments similar in size and form (Fig. 181 *J*), of peculiar shape, as shown, the ventral appendage bearing two long setae and the main body of the plate with two very small setae. Plates of the seventh segment of the same form but with the margins not free. Plates of the eighth segment merely slightly sclerotic areas. *Genital region* as shown in Fig. 181 *G*. Gonopophyses vestigial, their position shown merely by small setae; ninth segment with a pair of blade-like spines and a cluster of setae at each posterior angle.

MALE (Fig. 180). Length 1.25 mm. In general characters closely similar to the female. *Antennae* (Fig. 181 *H*) with a pair of stout, recurved setae on the dorsal side of the third segment. *Genitalia* (Fig. 181 *B, C, D, E, F, K*) of a very peculiar type; basal plate (*bp*) broad, slightly excavated posteriorly; parameres (*par;* Fig. 181 *E*) slender and blade-like, with a hook at the base which grasps the arm of the pseudo-

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penis and also with a small hook near the apex; pseudopenis (*pp;* Fig. 181 *D*) long and slender, Y-shaped, its arms reaching almost to the basal plate and inclosing the small, sclerotic penis (*p;* Fig. 181 *C*); in addition to these usual structures there are present two lateral pieces (*x;* Fig. 181 *F*) of blade-like form, which seem to articulate with the sides of the parameres and a small mesal piece (*y;* Fig. 181 *B*) lying over the base of the penis.

IMMATURE STAGE (Fig. 182). A single immature stage, possibly the second, is represented in the material at hand. In this the general characters of head and thorax are practically as in the adult, with a somewhat more exaggerated tendency toward the development of tubercles. The abdomen presents only a pair of median ventral setae on each segment and shows traces of paratergites on the fourth and fifth segments.

Genus **LEMURPHTHIRUS** Bedford

1927. *Lemurphthirus,* Bedford, *Parasitology,* 19: 263.
1929. *Lemurphthirus,* Ewing, *Manual of External Parasites,* p. 143.

Anoplura without eyes; with five-segmented antennae which are sexually dimorphic, the male having the third segment armed dorsally with a pair of stout, recurved setae; head broad, with strongly constricted occipital region; thorax, although fundamentally of the same structure as in all other members of the Order, strongly modified by the great elongation of the prothoracic elements, the meso- and metathoracic portions forming scarcely more than the posterior fourth of the total length; sternal plate present; legs relatively very small and widely separated, the anterior very weak, the middle and posterior pairs stouter, subequal; paratergal plates of the abdomen present definitely only on the second segment; tergal and sternal plates weakly developed, there being but a single plate and a single row of setae to each segment, except that in both sexes the second tergite may be considered to have two rows and two plates. Spiracles present on the third to the eighth abdominal segments.

HOSTS. Known only from the genus *Galago,* of the family Lemuridae.

TYPE OF THE GENUS. *Lemurphthirus galagus* Bedford, the only included species.

NOTES.—The type of this genus is an extraordinary form, the peculiarities of which, however, arise from a remarkable exaggeration of structures common to all the sucking lice and not, as would at first glance appear, from the introduction of any new elements. These peculiarities have only to do with the thorax, the remaining parts of the body presenting nothing at all out of the ordinary. The material at hand does not permit a study as complete as is desirable, but it is sufficient to render the homologies of the parts reasonably clear.

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Unfortunately, owing to the plan upon which this series of papers has been arranged, the detailed discussion of the morphology of the sucking lice as a group will not appear until one of the final sections. For the present we may merely anticipate conclusions which will later be fully explained and note that the apparent notum of the thorax of the sucking lice is formed almost entirely from the pleurites, the true notum being represented by the median furrow and pit, the latter being present only in certain forms. The transverse bars, which are a conspicuous feature of the apparent notum, are merely phragmata formed along the lines between the episterna and epimera of the respective segments. These phragmata of the meso- and metathorax commonly unite into a single transverse bar which may inclose medially the notal pit, while the prothoracic pleurites, which may be completely fused with each other at the mid line of the dorsum, thus suppressing the true notum entirely in this region, usually remain separate from those of the meso- and metathorax.

In *Lemurphthirus galagus* (Fig. 184 *A*) the prothoracic pleurites have become completely fused along the median line of the dorsum and are greatly elongated, crowding the remaining parts into the posterior fourth of the thoracic dorsum. The lateral margins have become slightly revolute, carrying the condyles and the spiracles somewhat to the apparent ventral side. The lateral, longitudinal bars, which frequently connect the coxal condyles, are here enlarged into distinct plates which project between the pairs of coxae on the ventral side. But the homologies seem to be quite clear. In the original description of the genus the thoracic spiracles are said to be lacking, but this is in error.

Attention may be called here to the extraordinary resemblance of the head to that of the typical species of *Neohaematopinus*. In fact, the head and antennae, the latter even to the enlarged seta on the posterior border of the first segment, might almost have been transferred from *N. sciuropteri* (Osborn). Furthermore, the thoracic sternal plate and even the highly modified thorax are not so greatly different from those of *N. sciuropteri*. However startling such a suggestion may be, there is apparently a closer connection of *Lemurphthirus* with *Neohaematopinus* than with any other group. Ewing has placed the genus in the Pediculidae, but such a position is utterly untenable and was undoubtedly based more upon a concession to the commonly—although not necessarily correctly—held view as to the relationship of its host with the Primates than upon any knowledge of the insect.

Lemurphthirus galagus Bedford

FIGS. 183, 184

1927. *Lemurphthirus galagus* Bedford, *Parasitology*, 19: 263–264; 2 t. figs.
1929. *Lemurphthirus galagus* Bedford, Bedford, *Report of the Director of Veterinary Services, Union of South Africa*, 15: 501–502; fig. 1.

PREVIOUS RECORDS. From *Galagus moholi*, Transvaal and Southwest Africa.

SPECIMENS EXAMINED. A single female from the type lot received through the kindness of G. A. H. Bedford and two males and two females from *Galago* sp., without indication of locality (British Museum).

FEMALE (Fig. 183). Length 1.75–2.00 mm. *Head* very broad, the antennae continuous with the flatly rounded anterior margin, the postantennal angles prominent, the lateral margins of the hind head parallel,

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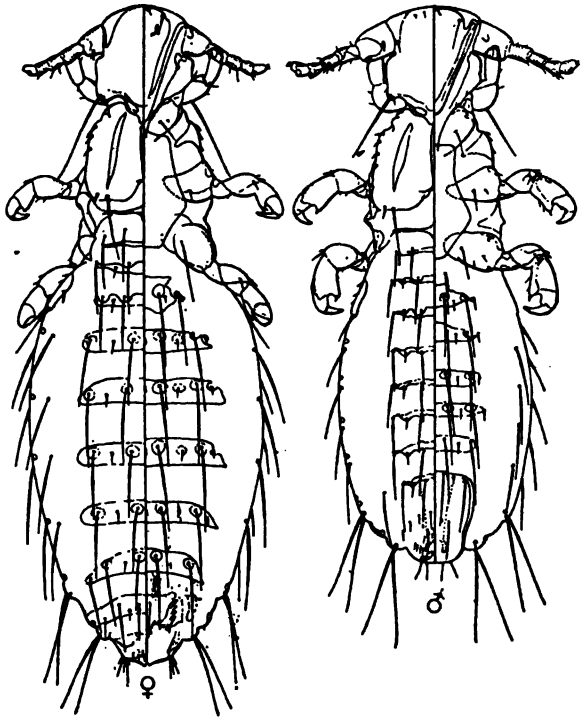

FIG. 183.—*Lemurphthirus galagus* Bedford, male and female.

the occipital region much constricted and strongly sclerotic, the ventral side with an elevated, V-shaped gular region. *Antennae* (Fig. 184 *C*) with the first segment quite large and stout, and bearing a thorn-like seta dorsally near the distal, post-axial angle.

Thorax (Fig. 184 *A*) as described for the genus, elongate, the small, weak legs widely separated. Prothorax with a strongly sclerotic median bar which articulates anteriorly with the occiput; lateral margin with several small, stout setae. Meso- and metathoracic phragma conspicuous, inclosing a slit-like median pit. Sternal plate (Fig. 184 *F*) very large, covering the bases of the coxae. *Legs* (Fig. 184 *G*) presenting no unusual features.

Abdomen with the tergal and sternal plates weakly sclerotized, bearing for the most part four long and two small setae, the bases of the larger setae surrounded by a non-sclerotic area. The number of tergal plates is greater by one than the number of segments and it appears probable that two plates belong to the second segment. Each segment, from the third to the eighth, with a pair of long, widely separated marginal setae. Spir-

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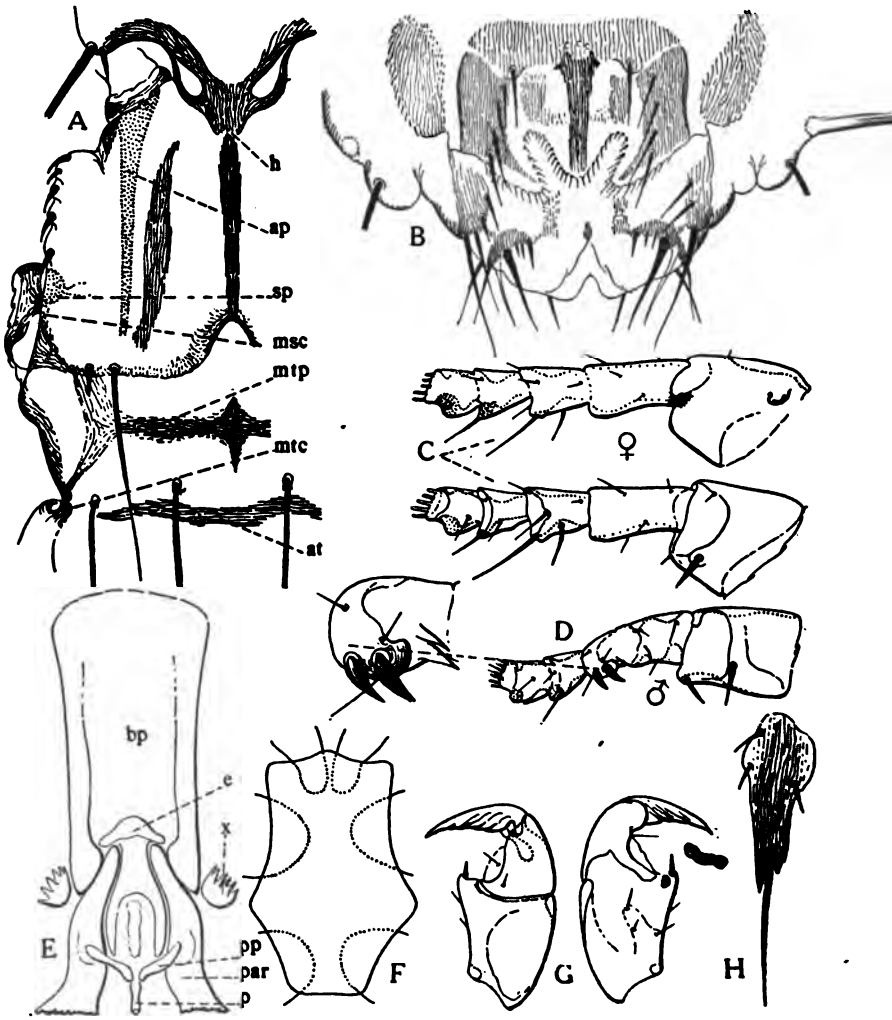

FIG. 184.—*Lemurphthirus galagus* Bedford: *A*, dorsum of thorax and portion of head (*h*, head; *ap*, prothoracic apophysis; *sp*, spiracle; *msc*, mesothoracic condyle; *mtp*, metathoracic phragma; *mtc*, metathoracic condyle; *at*, first abdominal tergite); *B*, genital region of female; *C*, antennae of female, dorsal and ventral aspects; *D*, antenna of male and detail of third segment, dorsal aspect; *E*, genitalia of male; *F*, sternal plate; *G*, posterior (left) and anterior (right) aspects of posterior tibia and tarsus; *H*, paratergite of second segment.

acles small, present on the third to eighth segments. ***Paratergal plates*** present only on the second segment, each being merely a small, elongate

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plate (Fig. 184 *H*) with a moderately long seta at the apex and three or four small setae at the base.

Genital region (Fig. 184 *B*) very complex, too much so to be described.

MALE (Fig. 183). Length 1.25 mm. In general very similar to the female and having the same arrangement of the abdominal tergites and sternites, the plates, however, smaller and more obscure than in the female. *Antennae* (Fig. 184 *D*) with the first segment very large, the third with the apical pre-axial angle forming a recurved process which bears a pair of short, thorn-like setae. *Genitalia* (Fig. 184 *E*) with a broad basal plate (*bp*); with the parameres (*par*) of peculiar form, their diverging apices flattened, truncate, and slightly serrate; pseudopenis (*pp*) if present represented merely by two small rods; penis (*p*) a small sclerotic tube between the apices of the parameres; endomeral piece (*e*) elongate T-shape and with the stem forked. Lying at the side of the genitalia are two small pieces (*x*) of unknown homology.

Genus **DOCOPHTHIRUS** Waterston

1923. *Docophthirus* Waterston, *Bulletin Entomological Research*, 14: 101.

Anoplura without eyes; with five-segmented antennae which apparently are not sexually dimorphic; anterior legs small and weak, middle and posterior legs large and heavy, with stout claw; paratergal plates present on second to seventh segments; abdominal segments of female for the most part with two transverse rows of setae both dorsally and ventrally and with plates developed apparently only in connection with the anterior row of the dorsal segments; abdominal segments of male with but a single row of setae, except for the second tergite, which may be considered as having two, the dorsal rows accompanied by plates; head beneath and the first antennal segment armed with stout hooks, the head broad, with but slight post-antennal angles and without a constricted occipital region; thorax without the usual prothoracic pleural apophysis and prothoracic pleural ridge, sternal plate apparently lacking. Spiracles present on third to eighth abdominal segments.

HOSTS. The genus *Anathana*, of the family Tupaiidae, the "tree shrews."

TYPE OF THE GENUS. *Docophthirus acinetus* Waterston, the only included species.

NOTES.—The absence of the prothoracic pleural apodeme and the prothoracic pleural ridge seems to connect this genus with *Phthirpediculus*. None of the known material is in good condition, and it is possible that examination of better specimens will throw additional light on the genus.

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Docophthirus acinetus Waterston

FIGS. 185, 186

1923. *Docophthirus acinetus* Waterston, *Bulletin of Entomological Research*, **14**: 101–102; figs. 1*a*, 21*a*, *b*.

PREVIOUS RECORDS. Known only from the original description, from *Anathana ellioti*, Madras, India.

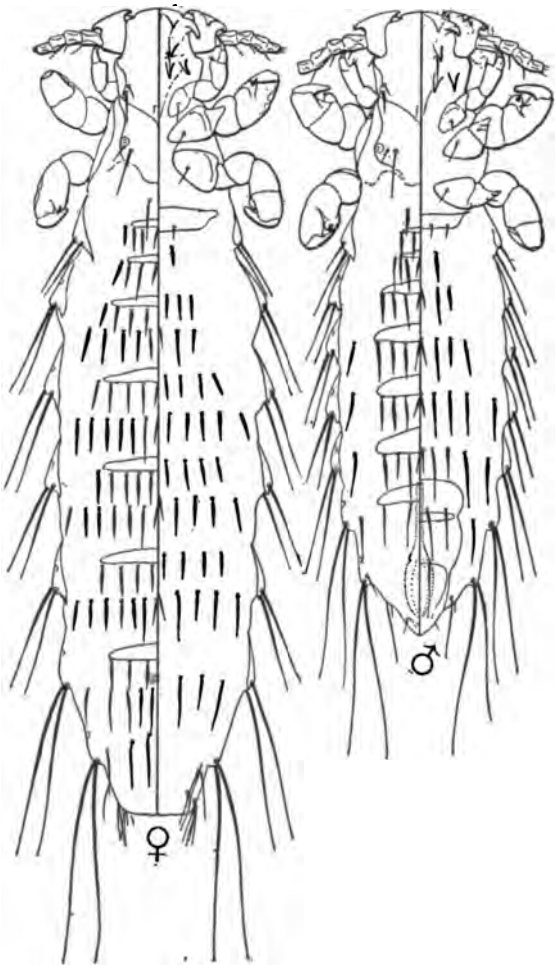

FIG. 185.—*Docophthirus acinetus* Waterston, male and female.

SPECIMENS EXAMINED. The type lot. It may be noted that the specimen in the British Museum indicated as the holotype is labeled as from

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"Uria grylle mandii, Black Guillemot, Spitzbergen, 1874, Rev. A. E. Eaton col." Very evidently some error in labeling or otherwise has occurred.

FEMALE (Fig. 185). Length 1.9–2 mm. An elongate, slender species. *Head* (Fig. 186 *A*) short and broad, the antennae continuous with the flat anterior margin, the post-antennal angles moderately prominent, the occipital angles barely indicated; ventral side with a series of stout, strongly sclerotic hooks. *Antennae* of normal form, except the first segment much enlarged and with both basal and distal anterior angles prolonged into hooks and with a third hook on the ventral side along the anterior margin.

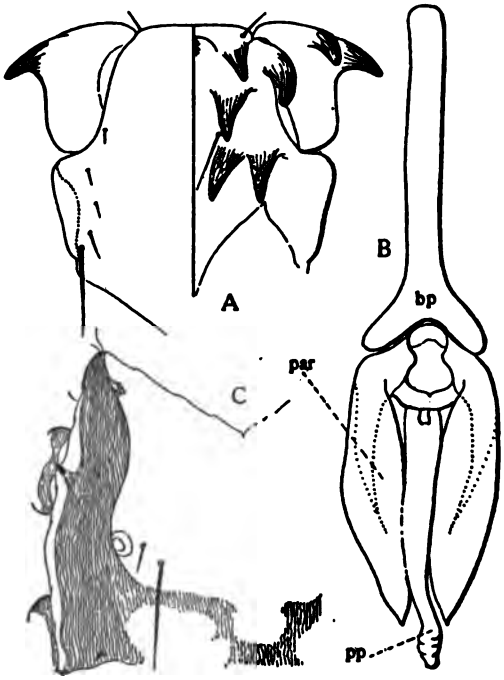

FIG. 186.—*Docophthirus acinetus* Waterston: *A*, head; *B*, genitalia of male; *C*, dorsum of thorax.

Thorax longer and wider than the head, somewhat trapezoidal, the lateral margins straight (Fig. 186 *C*). The lateral band connecting the condyles is broad and heavy, the prothoracic pleural apophysis and pleural ridge are lacking, the spiracle is very small and set far behind the middle coxal condyle, and the mesothoracic pleural ridge is faint and continued across the meson. *Sternal plate* apparently lacking. *Legs* presenting no unusual features.

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Abdomen long and slender, the setae rather stout, the anterior row of each tergite associated with a well-defined plate. Paratergal plates small but distinct, the posterior angle both dorsally and ventrally prolonged into a slight point and each plate, as well as the eighth segment, bearing a pair of long, slender setae. The exact form of the plates cannot be figured from the available specimens, nor can the details of the genital region be determined.

MALE (Fig. 185). Length 1.3 mm. Closely resembling the female in general features except for the presence of but a single row of setae dorsally and ventrally on each abdominal segment other than the second tergite. *Tergal* plates larger than in the female. *Antennae* apparently the same as in the female. *Genitalia* (Fig. 186 *B*) of a simple type, the basal plate long and slender, expanded at the apex, the parameres (*par*) long and broad and almost parallel. What is apparently the pseudopenis (*pp*) is a long, rod-like, and somewhat irregular piece that extends from beyond the apex of the parameres almost to their bases, where it expands or perhaps becomes confused with the endomeral piece.

NOTES.—The condition of the material, which was improperly prepared, is poor, leaving some points in doubt. It is possible, for example, that the antennae of the male actually differ from those of the female in the character of the third segment.

Genus **HAMOPHTHIRIUS** Mjöberg

1925. *Hamophthirius* Mjöberg, *Psyche*, 32: 283.

Specimens of this genus have not been available and it is possible to quote only the original description.

"Antennae three-jointed, first joint very strongly developed, with a large chitinous hook; head anteriorly very strongly constricted, with a strong and sharp chitinous hook on each side, posterior half transverse, nearly twice as broad, posterior angles protruding, forming two processes, posterior margin strongly emarginate on each side of the middle; thoracic segments coalescent, parallel-sided, all pairs of legs fairly equally developed; abdomen of normal type, with pleural sclerites developed on segments two to six. Integument scaly."

HOSTS. Known only from the genus *Galeopithecus*, of the family Lemuridae.

TYPE OF THE GENUS. *Hamophthirius galeopitheci* Mjöberg.

NOTE.—As far as can be determined from the description, this genus is possibly more or less related to *Docophthirus*, although in certain respects, notably the form of the head and the character of the legs, it suggests *Lemurphthirus*.

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Hamophthirius galeopitheci Mjöberg

FIG. 187

1925. *Hamophthirius galeopitheci* Mjöberg, *Psyche*, 32: 283–284; fig.

PREVIOUS RECORDS. From *Galeopithecus* sp., Fesseltan, British North Borneo.

NOTE.—In the absence of specimens the original description is quoted and the very inadequate original figures are reproduced.

"Yellowish, depressed; head in front strongly chitinized; lateral hooks parallel, very sharp; antennae with the first joint enormously developed, with a very large hook and ventrally on the posterior margin with a smaller one; second joint shorter than the third, both nearly parallel-sided; third joint with two lateral sensitive fossae, its terminal field with

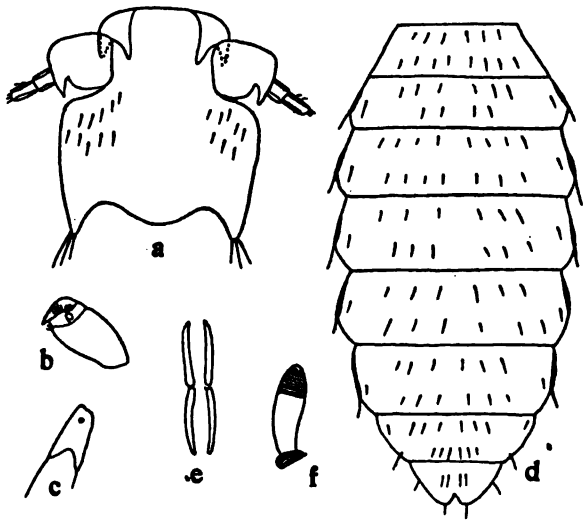

FIG. 187.—*Hamophthirius galeopitheci* Mjöberg: *a*, head; *b*, tarsal claw; *c*, paratergite; *d*, abdomen; *e*, genitalia of male; *f*, egg. (After Mjöberg.)

eight to ten sensitive seta-like organs. On the ventral side of the head posteriorly there is a dagger-like spine at each side; posterior lower angles obtuse, the upper angles distinctly produced, rounded at the tips, and provided with three long setae. Thoracic segments coalescent, anterior angles of prothorax rounded; at the middle of the anterior margin deeply excised to receive the corresponding protruding part of the occipital region of the head; legs moderate in size, fairly equally strongly developed; tibiae with four small terminal chitinous spines opposite to the claw; claws large,

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distinctly striated. Abdomen in both sexes of normal development; pleural sclerites small, posteriorly emarginate; tergites and sternites with two more or less regular rows of fine depressed setae. Chitinous parts of genitalia in male forming two parallel jointed rods, simple gonapods of normal type, forming two flat lobes of more or less triangular shape and provided with numerous chitinous setae; last segment produced into two small, unjointed processes.

"Length of body: male 1.7 mm.; female 2.5 mm."

Genus **ANCISTROPLAX** Waterston

1929. *Ancistroplax* Waterston, *Parasitology*, 21: 161.

Anoplura without eyes; with four-segmented antennae, which are not sexually dimorphic; anterior legs small and weak, with slender claw, middle legs slightly larger in the female and noticeably so in the male but of the same type, posterior legs highly modified, with all the parts very large and stout; paratergal plates present on the first to eighth segments of the abdomen, those of the first segment very small and lying on the dorsum, those of the third to seventh segments very large and overlapping, those of the fourth to sixth segments divided longitudinally into two plates; female with the fourth to seventh segments each with three tergal and three sternal plates and three rows of setae; male with but one tergal and sternal plate on each segment but these in part with two rows of setae; male with the tergal plate of the sixth abdominal segment modified into a pair of strong hooks; sternite of the second segment in both sexes divided longitudinally into two plates. Spiracles present on third to eighth abdominal segments.

Hosts. As far as known occurring only on the genus *Crocidura* of the family Soricidae of the Insectivora.

Type of the Genus. *Ancistroplax crocidurae* Waterston, the only included species.

Notes.—As Waterston pointed out, this genus is evidently closely related to *Schizophthirus* and *Haematopinoides*. To a certain extent it combines the characters of these two genera, the antennae being identical with those of *Haematopinoides* and the paratergites being essentially like those of *Schizophthirus*. It shares with these two genera the longitudinally divided sternite of the second segment. Its peculiar combination of characters, however, seems adequately to justify a distinct genus.

Ancistroplax crocidurae Waterston

Figs. 188, 189

1929. *Ancistroplax crocidurae* Waterston, *Parasitology*, 21: 161–163; t. fig.

Previous Records. But a single record, from *Crocidura horsfield* Ceylon.

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SPECIMENS EXAMINED. Paratypes of both sexes.

FEMALE (Fig. 188). Length 1.25 mm. *Head* (Fig. 189 *H*) only slightly longer than broad, weakly pigmented, with distinct, sclerotic ventral plate which bears a number of crescentic markings; post-antennal angles quite prominent, the occipital angles rounded and without the long setae that ordinarily occur in this region, the hind head constricted into a

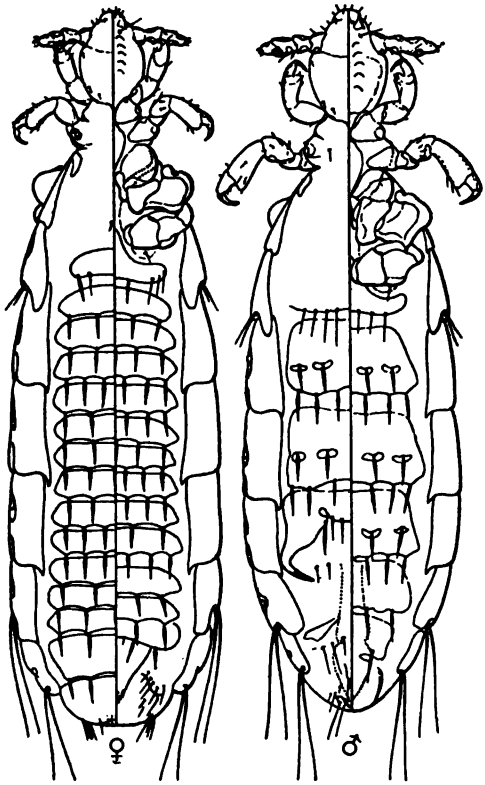

FIG. 188.—*Ancistroplax crocidurae* Waterston, male and female.

slender neck. *Antennae* (Fig. 189 *C*) clearly four-segmented, the terminal segment with a large sensorium. *Thorax* very small, shorter than the head; sternal plate (Fig. 189 *D*) somewhat wedge-shaped. Posterior legs with all the parts enlarged and flattened, the whole structure being very stout.

Abdomen elongate and slender. First and second segments without tergal plates, the third with but one, the fourth to seventh with three, the eighth and ninth with one. First segment apparently without a sternal

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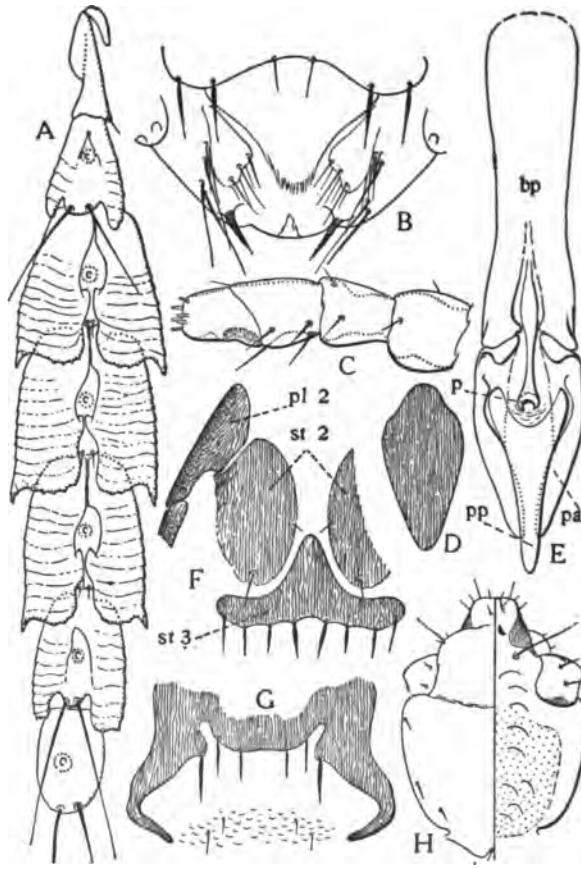

Fig. 189.—*Ancistroplax crocidurae* Waterston: *A*, paratergites of female; *B*, genital region of female; *C*, antenna; *D*, sternal plate; *E*, genitalia of male; *F*, venter of base of abdomen (*pl 2*, paratergite of second segment; *st 2*, sternites of second segment; *st 3*, sternite of third segment); *G*, seventh tergite of male; *H*, head.

plate; second (Fig. 189 *F*) with the sternite divided longitudinally into two oval plates which seem to articulate with the corresponding paratergites; third segment with a single plate, which is medially produced between the plates of the second segment; fourth to seventh segments each with three plates. Plates for the most part with four to six stout setae. *Genital region* (Fig. 189 *B*) with no specially distinctive features. *Paratergal plates* (Fig. 189 *A*) as described for the genus, for the most part marked with transverse lines. Spiracles present on the third to eighth segments, small.

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MALE (Fig. 188). Length 1.06 mm. Differing from the female conspicuously in the tergal and sternal plates of the abdomen. Tergal plate of the third segment ill-defined, bearing six or eight slender setae. Tergal plates of the fourth and fifth segments occupying the entire segment and bearing two rows of stout setae, the bases of which are surrounded by non-sclerotic areas, which seem to indicate that the plate is formed by the incomplete fusion of two plates. Tergal plate of the sixth segment (Fig. 189 *G*) modified in an extraordinary fashion, its posterior margin deeply emarginate and the posterior angles produced into a pair of strong hooks. Tergite of the seventh segment membranous and of the eighth with but a pair of small sclerotic areas. Sternites of the second and third segments as in the female; of the fourth to seventh like the unmodified tergites. *Genitalia* (Fig. 189 *E*) relatively small, with the basal plate (*bp*) slender, divided in its apical fourth into two arms which partially inclose the slender penis (*p*) and which articulate with the bases of the slender, tapering parameres (*par*), the latter inclosing the simple, wedge-shaped pseudopenis (*pp*).

Genus **BATHYERGICOLA** Bedford

1929. *Bathyergicola* Bedford, *Annual Report, Director of Veterinary Services, Union of South Africa*, 15: 505.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; with the anterior and middle legs of approximately the same size and form, with slender claw, the posterior legs stout, with stout claw; paratergal plates present typically on the second to sixth or seventh segments (in one species present only on the fourth to seventh), the plate of the second segment not divided longitudinally; abdomen membranous and with but a single row of setae on each segment dorsally and ventrally in both male and female; head tending to somewhat cylindrical in form, with slight or no post-antennal angles but with a distinctly constricted occipital region, the ventral side with a raised gular region; thorax with the notum completely obliterated. Spiracles present on the third to eighth abdominal segments.

HOSTS. Two of the included species are from members of the family Bathyergidae, the "mole rats," and the third from a member of the subfamily Lophiomyiinae of the family Muridae.

TYPE OF THE GENUS. *Bathyergicola hilli* Bedford.

NOTES.—There is considerable doubt in the mind of the writer—as there appears to have been in the mind of the describer of the genus—as to whether or not two of the included species, *B. hilli* Bedford and *B. lawrensis* Bedford, should be referred to the same genus. Although they occur upon hosts of the same family, they differ

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from each other rather markedly in the character of the legs and in the number of paratergal plates. A third species, here described as new, while occurring on a host of a different family, seems quite definitely congeneric with the type. There is about the three species, however, a certain facies that seems to indicate a relationship and they may well be kept together for a time, especially as the males of two of the species are unknown.

It is possible that *Bathyergicola* may eventually prove to be a synonym of *Proenderleinellus.*

1. Bathyergicola hilli Bedford

FIGS. 190, 191

1929. *Bathyergicola hilli* Bedford, *Annual Report, Director of Veterinary Services, Union of South Africa,* 15: 506; figs. 6, 7, 7*a*, 8.

PREVIOUS RECORDS. From *Georychus hottentotus,* Pietermaritzburg, Natal, South Africa.

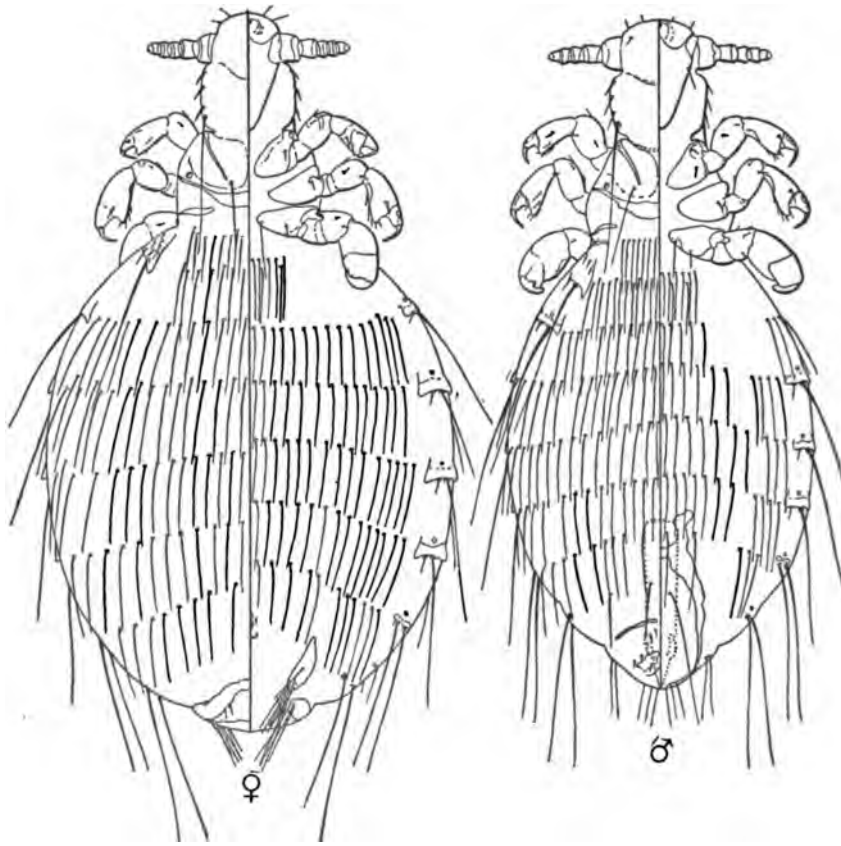

FIG. 190.—*Bathyergicola hilli* Bedford, male and female.

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SPECIMENS EXAMINED. Males and females from the type host and locality received through the kindness of Lawrence Hill.

FEMALE (Fig. 190). Length 1.5 mm. A stout-bodied species. *Head* almost truncate anteriorly and with the antennae set slightly back from the anterior margin; post-antennal angles slight, rounded; lateral margins of the hind head with several small setae; ventral side with a raised gular region which forms a sclerotic plate; dorsal side of the head without sclerotization. *Antennae* rather short and stout.

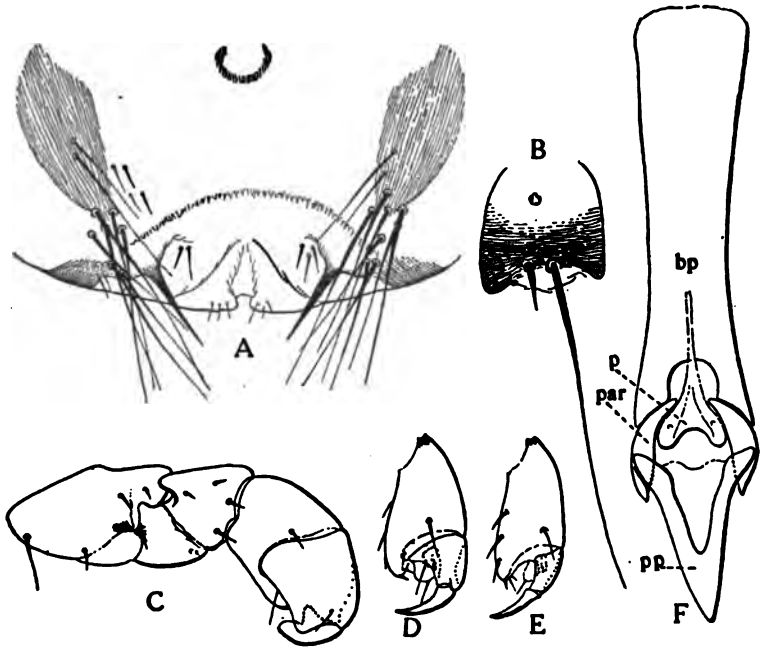

FIG. 191.—*Bathyergicola hilli* Bedford: *A*, genital region of female; *B*, paratergite; *C*, posterior leg; *D*, middle tibia and tarsus; *E*, anterior tibia and tarsus; *F*, genitalia of male.

Thorax slightly shorter than the head, somewhat quadrate; sternal plate not sclerotized. Anterior and middle legs of the same form and of nearly the same size (Fig. 191 *D*, *E*) with rather small, slender claw; posterior legs (Fig. 191 *C*) stouter, although actually not longer, the femur with a conspicuous spur at the base on the anterior margin, the tibia and tarsus flattened, the claw stout.

Abdomen membranous throughout except for the narrow ninth tergite, each segment both dorsally and ventrally, from the third to the eighth, with an unbroken row of many quite long and slender setae. *Paratergal plates*

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definitely developed on the second to seventh segments, all quite similar, rather small, somewhat quadrate in form, slightly sclerotic and bearing one very small and one very long seta on the posterior margin (Fig. 191 *B*); spiracles very small. Seventh segment with merely a small, sclerotic area about the base of the usual two long marginal setae. *Genital region* (Fig. 191 *A*) without a median sclerotized plate; gonopophyses quite large but with the apices not free; ninth sternite terminating in a stout spine at each angle.

MALE (Fig. 190). Length 1.25 mm. In general closely resembling the female. *Genitalia* (Fig. 191 *F*) with a long and rather stout basal plate (*bp*) which is excavated at the apex and partially incloses the small, curved parameres (*par*), the tips of which overlie the basal angles of the very large, stout, wedge-shaped pseudopenis (*pp*); between the bases of the parameres is a small piece which may be regarded as the statumen penis (*p*).

2. **Bathyergicola lawrensis** Bedford

FIG. 192

1929. *Bathyergicola lawrensis* Bedford, *Annual Report, Director of Veterinary Services, Union of South Africa*, 15: 506–507; figs. 7*b*, 9, 10.

PREVIOUS RECORDS. From *Bathyergus maritimus*, Cape Province, South Africa.

SPECIMENS EXAMINED. A female. Owing to some error in making notes, the origin and disposition of the specimen are not recorded. It is perhaps in the collections of the Molteno Institute.

FEMALE (Fig. 192). Length 2.11 mm. *Head* without post-antennal angles, thus having a rather cylindrical form; lateral margins of hind head with several setae; dorsal side quite strongly sclerotic, ventral side with the raised gular area quite strongly sclerotic (Fig. 192 *D*).

Thorax shorter than the head, somewhat quadrate; sternal area not sclerotized. Anterior and middle legs of the same size and form, rather stout and with a quite stout claw; posterior legs somewhat larger and with tibia and tarsus more flattened but of much the same form.

Abdomen membranous except for the very narrow ninth tergite, most of the segments with a median group of numerous slender setae, both dorsally and ventrally, with the submarginal area bare except for a single long dorsal setae and two ventral setae. *Paratergal plates* present on but the third to sixth segments, quite large and conspicuous, short and broad, with the angles (Fig. 192 *C*) forming hooked lobes, each with but a single long seta. *Genital region* (Fig. 192 *B*) without a sclerotic median plate;

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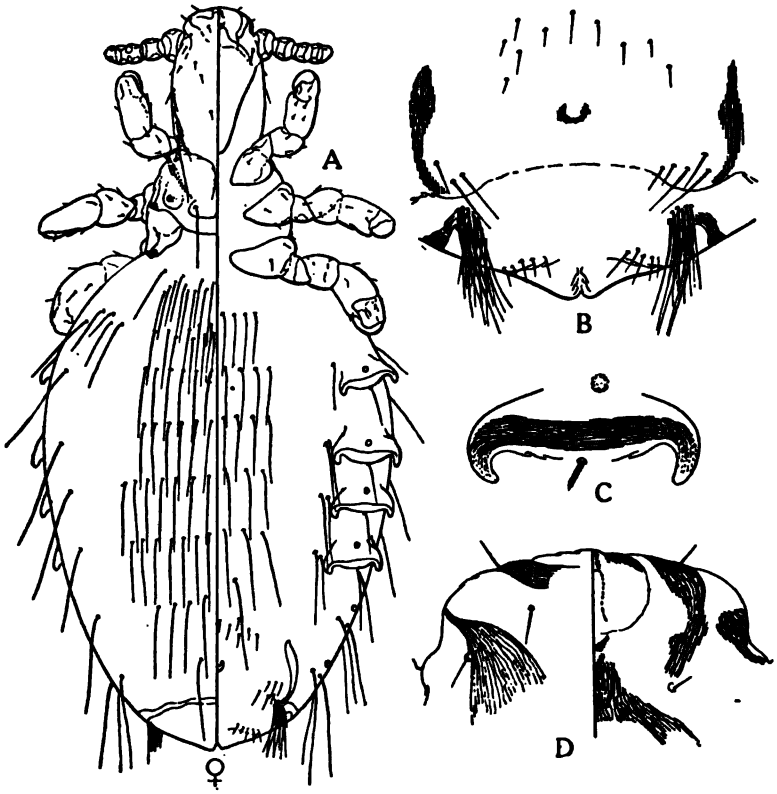

FIG. 192.—*Bathyergicola lawrensis* Bedford: *A*, female; *B*, genital region; *C*, paratergite; *D*, portion of anterior part of head.

gonopophyses small and narrow, their apices not free, the ninth sternite without a stout spine at each apical angle.

NOTES.—The male of this species is unknown. It will be noted that the species departs quite markedly from the genotype, and, as Bedford has suggested, it may perhaps eventually be referred to a distinct genus.

3. **Bathyergicola lophiomydis** n. sp.

FIG. 193

SPECIMENS EXAMINED. The holotype, a female, and two paratype females from *Lophiomys thomasi,* Mount Garguez, British East Africa; a paratype female from *Lophiomys ibeanus* (U.S.N.M. 184114); a paratype female from *Lophiomys ibeanus,* Nakroru, British East Africa (U.S.N.M. 755360).

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FEMALE (Fig. 193). Length 2.75 mm. *Head* without post-antennal angles, thus having a somewhat cylindrical appearance; lateral margins of the hind head with but one or two small setae; dorsal side of the head and the raised gular region quite strongly sclerotic.

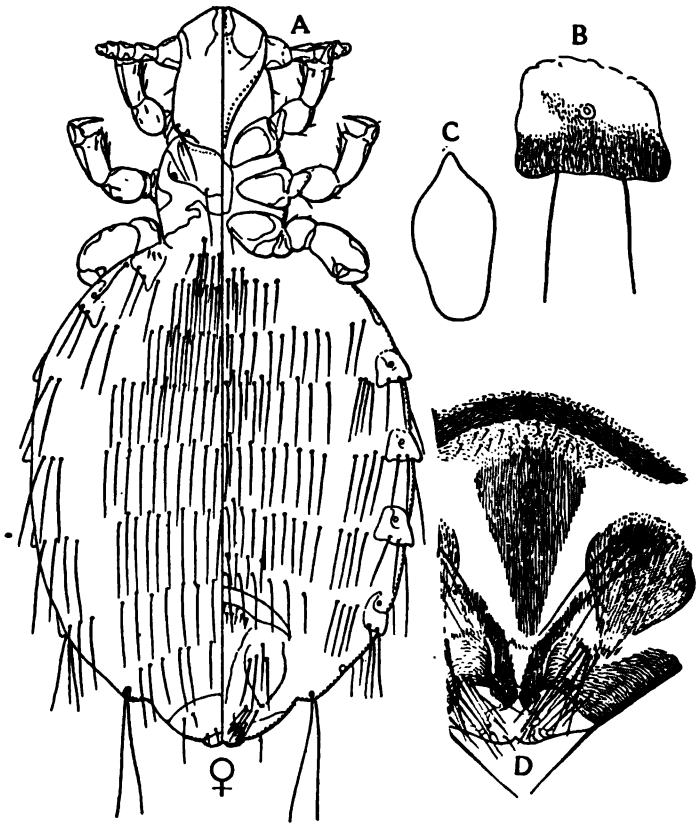

FIG. 193.—*Bathyergicola lophiomydis* n. sp.: *A*, female; *B*, paratergite; *C*, sternal plate; *D*, genital region.

Thorax slightly shorter than the head and but little wider, having a somewhat cylindrical appearance; sternal area with an irregular and variably formed sclerotic plate (Fig. 193 *C*). Anterior and middle legs of the same size and form, the tarsus not flattened, the claw slender; posterior legs not larger, but with the tibia and tarsus flattened and the claw stout.

Abdomen with paratergal plates on the second to seventh segments, these (Fig. 193 *B*) much of the same shape, quadrate and each with a pair of slender setae on the posterior margin; the posterior half slightly

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sclerotic. Both dorsal and ventral rows of setae arranged in a median group, with a sub-marginal bare area and a group of three or four setae near the margin. *Genital area* (Fig. 193 *D*) with a conspicuous, somewhat T-shaped median plate; gonopophyses quite large, the apices not free; ninth sternite with a small, stout spine at each apical angle.

NOTE.—The writer would regard this species as strictly congeneric with the genotype.

Genus **PROENDERLEINELLUS** Ewing

1923. *Proenderleinellus* Ewing, *Journal of the Washington Academy of Sciences*, 13: 147.

1929. *Proenderleinellus*, Ewing, *Manual of External Parasites*, p. 133.

Specimens of this genus not being at hand, it is possible only to quote the original description.

"Second abdominal segment not provided with a pair of ventral tubercle bearing plates. Number of pairs of abdominal pleural plates seven. Antennae without any tooth-like processes; and head without paired plates situated on ventral surface between the antennae. First and second pairs of legs subequal and smaller than the last pair. Tibiae of first and second legs broadened distally and tarsi of same legs broadened proximally, thus forming, with the claws, clasping structures; first and second tarsal claws simple. Parameres of male genitalia long, arm-like."

HOSTS. Known only from the rodent genus *Thryonomys*.

TYPE OF THE GENUS. *Proenderleinellus africanus* Ewing.

Proenderleinellus africanus Ewing

1923. *Proenderleinellus africanus* Ewing, *Journal of the Washington Academy of Sciences*, 13: 147.

PREVIOUS RECORDS. From *Thryonomys gregorianus pusillus* (erroneously cited as *Thryonomys gregor pusillus*), Majiya-Chumvi, British East Africa.

NOTES.—This species was based upon a single male specimen and in the absence of any figures it is difficult to visualize its appearance from the original description. The description is here quoted in full.

"Forehead fully twice as broad as long; postantennal region of head about as broad as long and with two pairs of dorsal setae, an anterior, minute pair just behind the antennae and a large posterior pair at the posterior angles. Antennae about as long as head; second segment the longest. Thorax with two pairs of dorsal setae, a small, very short, spine-

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like pair just inside and slightly in front of the thoracic spiracles and a very large, long curved pair just inside and slightly posterior of the spiracles. Anterior process, or manubrium, of sternum with parallel sides; sternum also with a posterior process extending between the posterior coxae. Abdomen with a lateral area both above and below without setae and between this lateral area and the pleurae on each typical segment are situated two setae. Typical pleural plates with two small, pectinate, posterior lateral lobes and between them are situated the two, large, subequal, straight pleural setae. In typical pleural plates the stigmata is situated near the posterior margin. Genital armature of male with broad, parallel-sided, distally emarginate basal plate; long curved parameres; and stout, heavily chitinized pseudo-penis. Posterior legs considerably enlarged, but not enormous, their expanded claws simple. Length of male 1.42 mm.; width of male, 0.57 mm."

Genus **EULINOGNATHUS** Cummings

1916. *Eulinognathus* Cummings, *Annals and Magazine of Natural History*, (8), 17: 90.
1916. *Eulinognathus*, Ferris, *Proceedings of the California Academy of Sciences*, (4), 6: 168.
1929. *Eulinognathus*, Ewing, *Manual of External Parasites*, p. 134.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; anterior legs small, with slender claw, middle and posterior legs typically sub-equal, large and stout and with stout claw (one species for the present referred to the genus has the middle legs intermediate in size between the others); paratergal (= pleural) plates of the abdomen present on the second to sixth segments; abdomen large and membranous, without tergal and sternal plates in either sex other than those of the ninth tergite and the genital region; both sexes in the type species and the male in others with but a single row of setae on each tergite and sternite, the females in other species with two rows; sternal plate of the thorax lacking in the type species; head with but slight post-antennal angles, without a constricted occipital region and without a raised gular region, typically beset with stout hooks on the ventral side near the anterior margin; genitalia of the males with the basal plate undivided, the parameres simple, the pseudopenis V-shaped. *Spiracles present on the third to seventh segments only, there thus being but five pairs on the abdomen.*

Hosts. From rodents of the families Pedetidae, Dipodidae, Octodontidae, and Chinchillidae.

Type of the Genus. *Eulinognathus denticulatus* Cummings.

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SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS

NOTE.—Names in italics are synonyms of the name with which they are coupled.

aculeatus (Neumann)
Haematopinus (Polyplax) aculeatus Neumann.
americanus Ewing.
denticulatus Cummings.
parvus (Kellogg and Ferris).
Haemodipsus parvus Kellogg and Ferris.

NOTES.—This genus as here constituted is probably somewhat heterogeneous, the only character that really binds the included species together being the possession of but five instead of the usual six pairs of spiracles on the abdomen, although because of this character it may be assumed that the species are actually more or less related to each other. The South American species seem to constitute the most discordant element, but unfortunately both are known only from the female and they must await the discovery of the males and possibly of additional species before they can be better understood.

1. Eulinognathus denticulatus Cummings

FIGS. 194, 195

1916. *Eulinognathus denticulatus* Cummings, *Annals and Magazine of Natural History,* (8), 17: 90–94; fig.
1916. *Eulinognathus denticulatus* Cummings, Ferris, *Proceedings of the California Academy of Sciences,* (4), 6: 168.
1927. *Eulinognathus denticulatus* Cummings, Bedford, *Report of the Director of Veterinary Education and Research, Union of South Africa,* 11–12: 738.
1929. *Eulinognathus denticulatus* Cummings, Bedford, *Report of the Director of Veterinary Services, Union of South Africa,* 15: 502.

PREVIOUS RECORDS. Recorded by Cummings from *Pedetes caffer,* without indication of locality, and by Bedford from the same host, Union of South Africa.

SPECIMENS EXAMINED. The type and other specimens in the British Museum from *Pedetes larvalis,* Nairobi, Kenya Colony, and *Pedetes* sp., Machakos, Kenya Colony; *Mastomys coucha,* Nakura, and *Rattus rattus,* Nairobi, Kenya Colony. Also specimens from *Pedetes caffer,* Kaalfontein, Transvaal (Bedford), and from *Pedetes* sp., Nairobi, Kenya Colony (U.S.N.M. 162194).

FEMALE (Fig. 194). Length 2 mm. A very stout-bodied form. *Head* (Fig. 195 *B*) truncate anteriorly and beset with a circlet of small, sclerotic points; post-antennal angles very slight, the morphological position of the posterior angles marked by a sclerotic plate which bears a long and a short seta. *Thorax* scarcely longer than the head and about twice as broad, dorsally, with a small, sclerotic spur arising just lateral of each spiracle and with the posterior lateral angles strongly sclerotic. Sternal plate lack-

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ing. First pair of legs small, with slender claw, second and third pairs large and stout, with stout claw.

Abdomen membranous throughout except for the usual sclerotic areas, each segment with but a single transverse row of many setae, these stout,

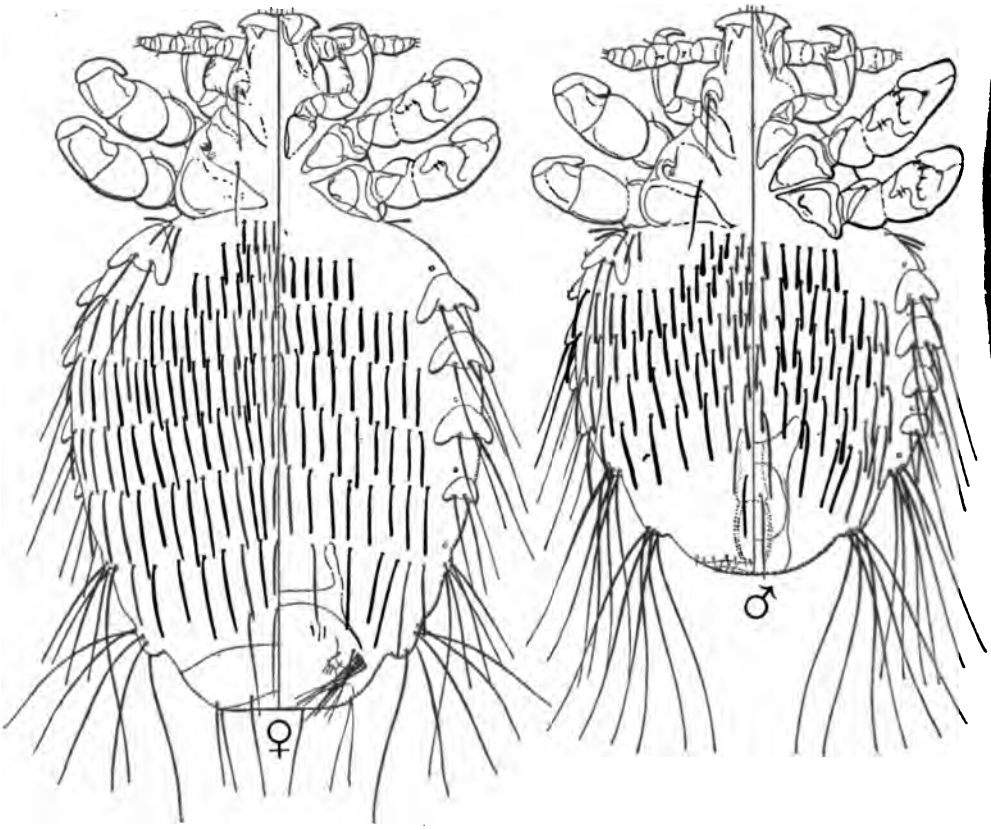

FIG. 194.—*Eulinognathus denticulatus* Cummings, male and female.

some rather strongly clavate, and all truncate at the apex. *Paratergal plates* triangular in form with the apical angles strongly lobate and each plate bearing a pair of long setae; spiracles very small and not included within the paratergal plates. *Genital plate* (Fig. 195 *A*) narrow, transverse, with a longitudinal arm at each end; gonopophyses very small; apical angles of the ninth segment beset with a slender spine.

MALE (Fig. 194). Length 1.25 mm. In general form and appearance closely resembling the female. *Genitalia* (Fig. 195 *C*) quite small, the basal plate undivided, the parameres (*par*) slender, tapering, and the

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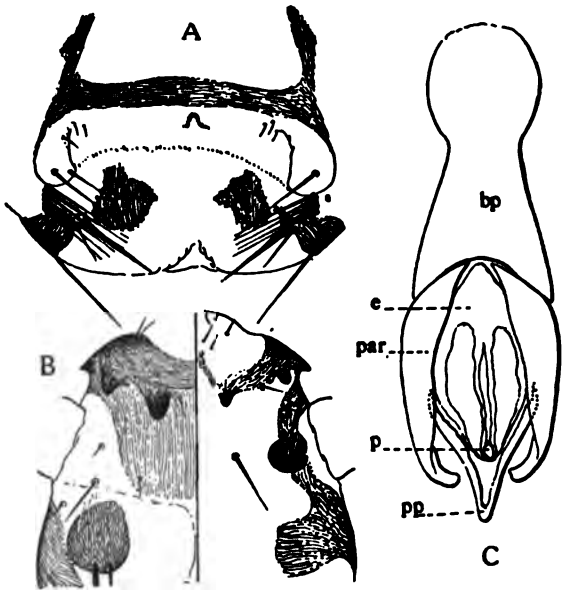

FIG. 195.—*Eulinognathus denticulatus* Cummings: *A*, genital region of female; *B*, anterior portion of head; *C*, genitalia of male.

apices curved inward and inclosing the small V-shaped pseudopenis; there is an indistinct, oval endomeral ring (*e*).

NOTES.—As indicated in the discussion of the genus, the writer is somewhat doubtful if the other species included in *Eulinognathus* are really congeneric with *E. denticulatus*, although certainly the generic separation of the males would present difficulties. *E. denticulatus* is a very distinctive and easily recognizable form.

2. Eulinognathus aculeatus (Neumann)

FIGS. 196, 197

1912. *Haematopinus (Polyplax) aculeatus* Neumann, *Bulletin de la Société Zoologique de France*, 37: 143–145; t. figs. 5–6.
1916. *Eulinognathus aculeatus* (Neumann), Ferris, *Proceedings of the California Academy of Sciences*, (4), 6: 168.

PREVIOUS RECORDS. Apparently known only from the original record, from "*Dipus* sp.," Djerba, Tunis.

SPECIMENS EXAMINED. From *Allactaga mongolica longior*, Chingning-chow, Kansu, China (U.S.N.M. 155188).

FEMALE (Fig. 196). Length, as given by Neumann for the types, 1.58 mm., but in the specimens at hand not exceeding 1.25 mm. A stout-bodied species. *Head* (Fig. 197 *A*) short and stout, truncate anteriorly

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and beset on the ventral side anteriorly with sclerotic tubercles. The number of these tubercles may vary slightly, but the typical arrangement is that of the figure, there being a tri-lobate tubercle at the anterior-lateral angle of the head, a single tubercle flanking the "mandibles" and a pair close together near each antennal base. Post-antennal angles of the head very slight and posterior-lateral angles obsolete. *Antennae* with a pair of small tubercles on the ventral side of the first segment and with a lobe or tubercle on the dorsal side of the same segment.

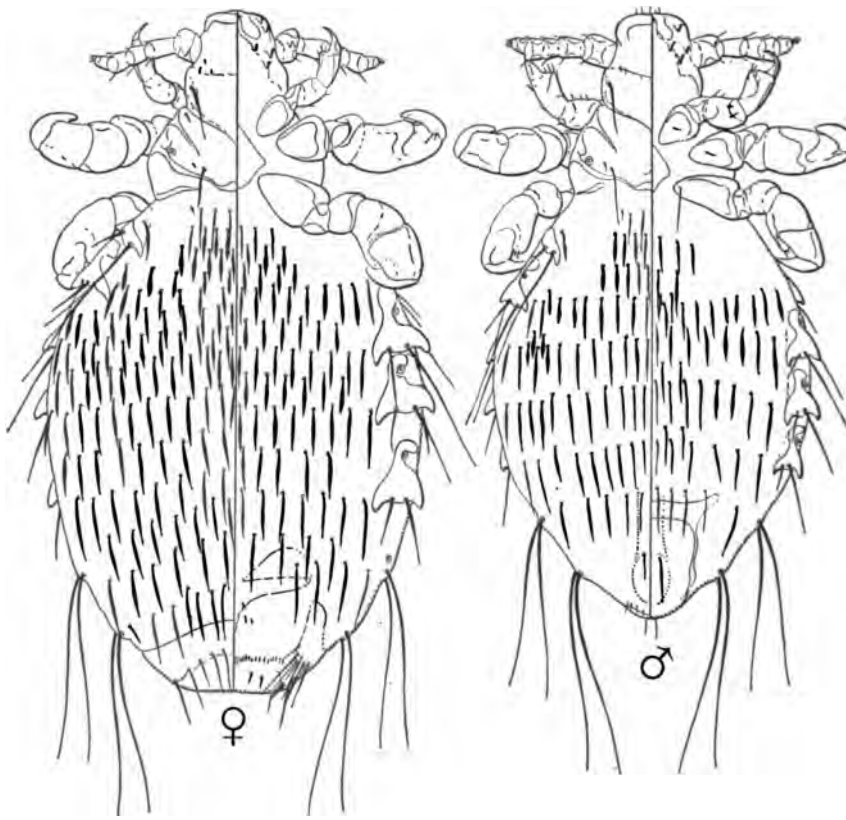

FIG. 196.—*Eulinognathus aculeatus* (Neumann), male and female. From specimens from *Allactaga mongolica*.

Thorax scarcely as long as the head and about twice as wide, a very small tubercle flanking each spiracle, the posterior lateral angles not sclerotic; sternal plate (Fig. 197 *E*) present, irregular in form. *Legs* of the type of the genus.

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Abdomen membranous throughout except for the usual areas, the segments both dorsally and ventrally for the most part with two rows of setae which are somewhat fusiform and toward the base of the abdomen tend to become noticeably stout. *Paratergal plates* (Fig. 197 *B*) somewhat elongate quadrate with the posterior angles strongly lobed, only a portion of the plate being sclerotized and this inclosing the spiracle; each plate with one short and one long seta. *Genital region* (Fig. 197 *D*) with a narrow, transverse genital plate; gonopophyses small and indistinct; apices of the ninth segment with a stout spine.

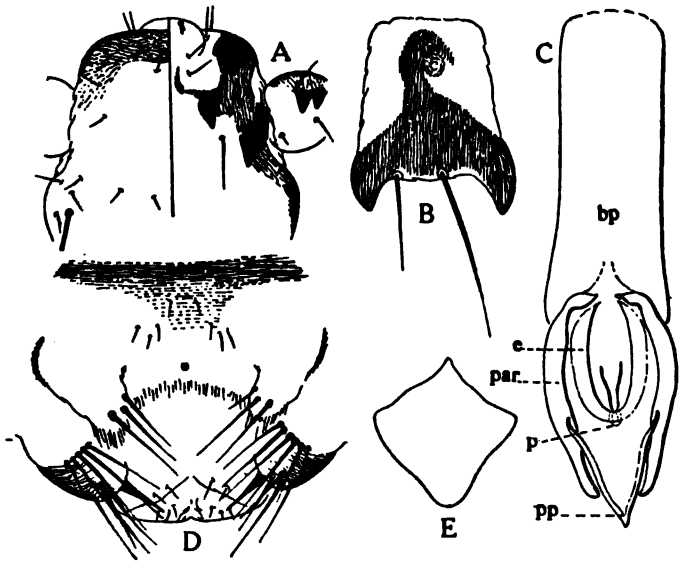

FIG. 197.—*Eulinognathus aculeatus* (Neumann): *A*, anterior portion of head; *B*, paratergite; *C*, genitalia of male; *D*, genital region of female; *E*, sternal plate.

MALE (Fig. 196). Length 1 mm. In general form closely resembling the female but with only a single row of setae on each abdominal tergite and sternite, except possibly the second tergite, which seems to have two. *Genitalia* (Fig. 197 *C*) quite similar to those of *E. denticulatus*, the basal plate (*bp*) large and broad, the parameres (*par*) about two-thirds as long as the basal plate, slender and curved and inclosing the small V-shaped pseudopenis (*pp*) and a ring-shaped endomeral piece (*e*).

NOTES.—The identification of the specimens at hand with *E. aculeatus* is open to some question. The description by Neumann was based upon the female alone, and his figures are incomplete. But in the form and arrangement of the tubercles on the ventral side of the head and in the form of the paratergal plates of the abdomen

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there is very close agreement. Neumann states that in his specimens the abdominal segments bear but a single row of setae. In view of other characters this statement may be discounted. The probabilities are that but a single species is involved.

3. **Eulinognathus biuncatus** n. sp.

FIGS. 198, 199

SPECIMENS EXAMINED. Numerous males and females from *Dipodip[illegible]s sowerbyi*, Shensi, China (U.S.N.M. 155092). Holotype a female.

FEMALE (Fig. 198). Length 1.25 mm. Somewhat less stout-bodie[illegible]d than the preceding species of the genus, but in general very closely re[illegible] sembling *E. aculeatus* (Neumann). *Head* (Fig. 199 *A*) with somewha[illegible]t more prominent post-antennal angles than in *E. aculeatus* and with but [illegible] pair of sclerotic hooks on each side ventrally near the anterior-latera[illegible]l

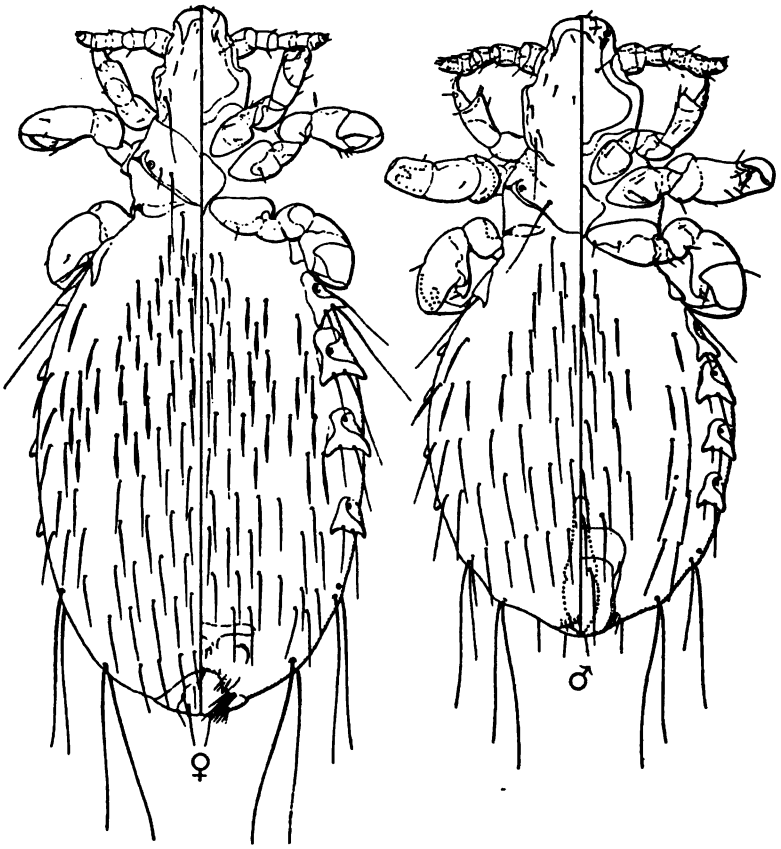

FIG. 198.—*Eulinognathus biuncatus* n. sp., male and female.

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angle. Thoracic and abdominal characters essentially as in *E. aculeatus,* the abdominal tergites and sternites for the most part with two rows of setae. *Genital region* (Fig. 199 *B*) differing only in slight details from that of *E. aculeatus.*

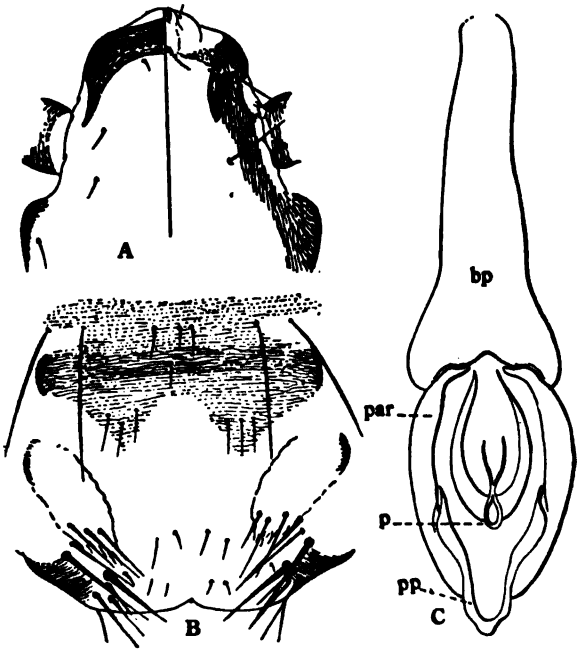

FIG. 199.—*Eulinognathus biuncatus* n. sp.: *A,* anterior portion of head; *B,* genital region of female; *C,* genitalia of male.

MALE (Fig. 198). Length 1 mm. *Head* and *thorax* as in the female. *Abdomen* with but a single row of setae to each segment, dorsally and ventrally, these somewhat less numerous and more slender than in *E. aculeatus.*

Genitalia (Fig. 199 *C*) essentially as in *E. aculeatus,* but the basal plate (*bp*) irregular and expanded posteriorly and the pseudopenis (*pp*) stouter.

NOTE.—This species is very close to *E. aculeatus,* differing significantly in the form of the head and the number of ventral hooks.

4. Eulinognathus americanus Ewing

FIG. 200

1923. *Eulinognathus americanus* Ewing, *Journal of the Washington Academy of Sciences,* 13: 148.

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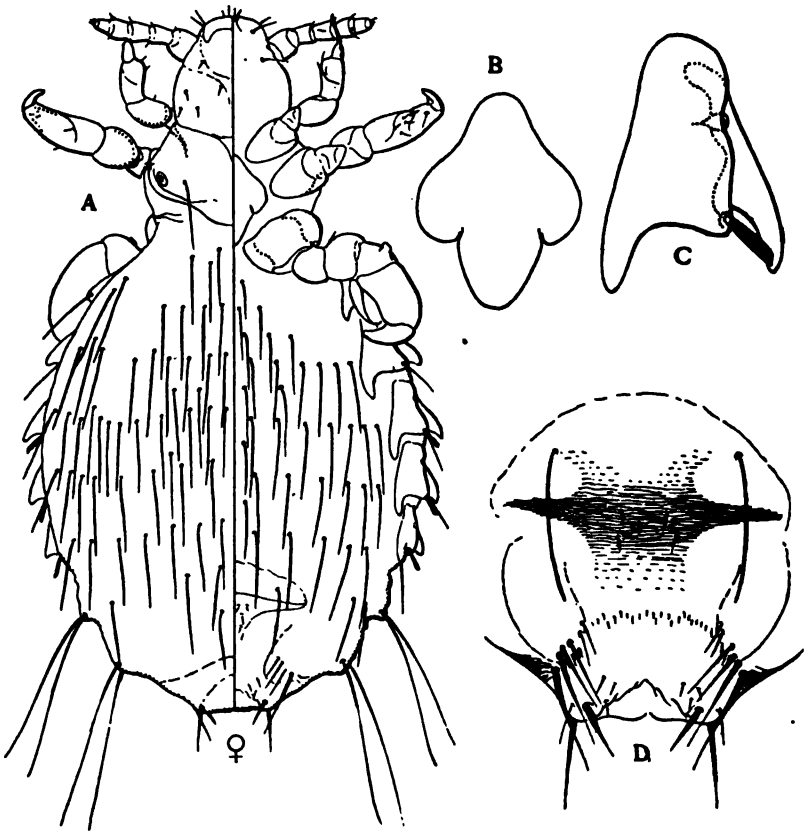

FIG. 200.—*Eulinognathus americanus* Ewing: *A*, female; *B*, sternal plate; *C*, paratergite; *D*, genital region of female.

PREVIOUS RECORDS. Known only from a single female from *Ctenomys brasiliensis*, Salade River, Paraguay.

SPECIMENS EXAMINED. A single female from *Ctenomys sericeus*, Upper Rio Chico, Patagonia (U.S.N.M. 84194).

FEMALE (Fig. 200). Length .8 mm. *Head* short and broad, slightly rounded anteriorly and with the antennae set close to the anterior margin, the post-antennal and posterior-lateral angles undeveloped; ventral side of the head without sclerotic hooks, the dorsal side with a sclerotic transverse bar along the anterior margin; the long seta usually present at the position of the posterior-lateral angles lacking. *Thorax* scarcely longer than the head and less than twice as wide; *sternal plate* (Fig. 200 *B*) strongly developed; *legs* with the middle pair intermediate in size between the first and third pairs.

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Abdomen as in the other species of the genus, the paratergal plates quite large, with the posterior angles strongly lobed, each plate with a short, truncate seta (Fig. 200 *C*) which has the appearance of being the base of a broken seta; spiracles inclosed within the paratergal plates. Abdominal segments, both dorsally and ventrally, with but one distinct row of setae, although on some segments a fragmentary second row appears, the setae numerous, slender, and truncate-tipped. *Genital region* (Fig. 200 *D*) with no distinctive features. Spiracles exceedingly small, present only on the third to seventh segments.

NOTES.—The original description of this species is inadequate and is unaccompanied by figures. The identification is based upon community of host genus and the possession of the curious truncate setae of the paratergal plates. It is worthy of note, however, that *Hoplopleura disgrega* Ferris, although otherwise very different in appearance, likewise possesses these curious, truncate setae on the paratergal plates. It is possible that the discovery of further species will reveal a connection between these forms in spite of the present classification.

That the species at hand is really congeneric with *E. denticulatus* or even with the other species here referred to *Eulinognathus* seems very doubtful to the present writer. However, it may be allowed to remain here for the present, the number of abdominal spiracles forming a convenient bond.

5. **Eulinognathus parvus** (Kellogg and Ferris)

FIG. 201

1915. *Haemodipsus parvus* Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, pp. 30–32; t. fig. 12; pl. 2, fig. 4; pl. 4, fig. 6.

1916. ? *parvus* Kellogg and Ferris, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 179.

PREVIOUS RECORDS. Known only from the original record, from *Lagidium peruanum,* Peru. The female only is described.

SPECIMENS EXAMINED. The types.

FEMALE (Fig. 201). Length .8 mm. *Head* very short, being as wide as long, without post-antennal angles and without a constricted occipital region, also without the usual long setae marking the position of the post-antennal angles; dorsal side somewhat sclerotic. *Thorax* scarcely longer than the head and about one and a half times as wide; *sternal plate* large and heavily sclerotic, with free margins, from nearly circular to oval in shape. First pair of *legs* small, with slender claw, second and third pairs large and stout, with stout claw and with division between tibia and tarsus obsolete.

Abdomen broadly oval, membranous throughout except for the ninth tergite and the genital plate; *paratergal plates* present on the second to

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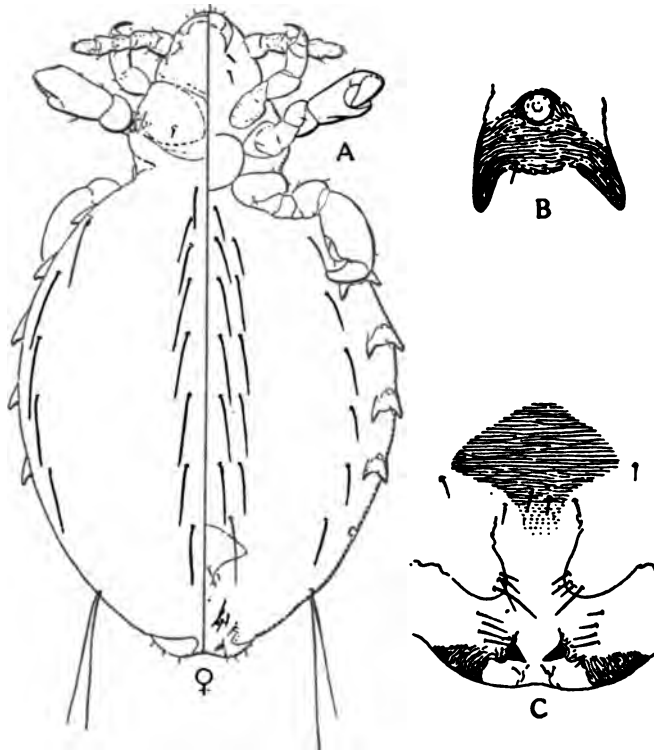

FIG. 201.—*Eulinognathus parvus* (Kellogg and Ferris): *A*, female; *B*, paratergite; *C*, genital region of female.

sixth segments, all of about the same shape (Fig. 201 *B*), the angles produced into sharp lobes and the posterior margin bearing a minute seta; spiracles very small, present only on the third to seventh segments; setae very few, arranged in a single row dorsally and ventrally on each segment, the dorsal row including but two median and a single submarginal seta, and the ventral row with two to four median and a submarginal seta. *Genital area* (Fig. 201 *C*) with a small genital plate; gonopophyses distinct; apical angles of the ninth sternite terminating in a tooth-like seta.

NOTES.—This species has suffered somewhat at the hands of the present writer, being first quite erroneously referred to *Haemodipsus*, later placed as of uncertain position and erroneously said to have been described from immature specimens. It was, however, suggested by the writer that the species might be referable to *Eulinognathus*, and this placing is here tentatively adopted, the possession of but five pairs of abdominal spiracles apparently allying it with that group. It will probably be referred to a distinct genus eventually, however.

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Genus **HAEMODIPSUS** Enderlein

1904. *Haemodipsus* Enderlein, *Zoologischer Anzeiger*, **28**: 139, 143.
1908. *Haemodipsus*, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 15.
1909. *Haematopinus* (*Polyplax*) Neumann, *Archives de Parasitologie*, **13**: 536.
1910. *Haemodipsus*, Mjöberg, *Arkiv för Zoologi*, **6**: 13: 165.
1915. *Haemodipsus*, Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals*, Stanford University Publications, University Series, pp. 27–28.
1916. *Haemodipsus*, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), **6**: 151.
1929. *Haemodipsus*, Ewing, *Manual of External Parasites*, pp. 136, 139.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; with the first pair of legs small and with slender claw, the second and third pairs equal, moderately stout and with stout claw; abdomen membranous throughout except for the usual areas on the ninth tergite and the genital region; paratergal plates (= pleurites) entirely lacking in the type species, present as minute vestiges on the third to sixth segments in others; each abdominal segment in both sexes with but a single transverse row of setae dorsally and ventrally; gonopophyses greatly reduced, being but mere vestiges marked by the presence of setae; thoracic sternal plate present in varying development, but with its margins not free. Spiracles present on the third to eighth abdominal segments.

HOSTS. Members of the rodent family Leporidae, the rabbits and hares.

TYPE OF THE GENUS. *Pediculus lyriocephalus* Burmeister.

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS

NOTE.—Names in italics are synonyms of the name with which they are coupled.

lyriocephalus (Burmeister).
Pediculus lyriocephalus Burmeister.
Pediculus lyriceps Nitzsch.
Haematopinus lyriocephalus (Burmeister).
Haematopinus (*Polyplax*) *lyriocephalus* (Burmeister).
parvus Kellogg and Ferris.
Eulinognathus parvus (Kellogg and Ferris).
setoni Ewing.
Haemodipsus ventricosus (Denny) (part; misidentification).
ventricosus (Denny) (part).
Haematopinus ventricosus Denny.
Polyplax ventricosa (Denny).
ventricosus (Denny) (part; misidentification).
Haemodipsus setoni Ewing.

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NOTES.—It is unfortunate that the species *lyriocephalus* was adopted as the type of *Haemodipsus*, since it is apparently quite rare and even yet is known only in the female. There is a very considerable degree of difference between it and the other two species here referred to the genus, but they do seem to constitute a natural group, although it must be admitted that perhaps the occurrence of these species upon hosts of a single family has unduly influenced our judgment as to the degree of relationship of the lice. *Haemodipsus parvus* Kellogg and Ferris is regarded by the writer as improperly referred to this genus and is here placed elsewhere.

1. Haemodipsus lyriocephalus (Burmeister)

FIGS. 202, 203

1839. *Pediculus lyriocephalus* Burmeister, *Genera Insectorum, Rhyncota, Species*, 11; fig. 7.

1842. *Haematopinus lyriocephalus* (Burmeister), Denny, *Monographia Anoplurorum Britanniae*, p. 27; pl. 24, fig. 4.

1864. *Pediculus lyriceps* Nitzsch, *Zeitschrift für den gesamten Naturwissenschaften*, 23: 24.

1874. *Haematopinus lyriocephalus* (Burmeister), Giebel, *Insecta Epizoa*, pp. 39–40; pl. 2, fig. 2.

1880. *Haematopinus lyriocephalus* (Burmeister), Piaget, *Les Pediculines*, pp. 641–642; pl. 52, fig. 5.

1904. *Haemodipsus lyriocephalus* (Burmeister), Enderlein, *Zoologischer Anzeiger*, 28: 143.

1908. *Haemodipsus lyriocephalus* (Burmeister), Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 15.

1909. *Haematopinus (Polyplax) lyriocephalus* (Burmeister), Neumann, *Archives de Parasitologie*, 13: 528.

1910. *Haemodipsus lyriocephalus* (Burmeister), Mjöberg, *Arkiv för Zoologi*, 6: 13: 165.

1913. *Haemodipsus lyriocephalus* (Burmeister), Evans, *Proceedings Royal Physical Society Edinburgh*, 19: 94.

1915. *Haemodipsus lyriocephalus* (Burmeister), Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals*, Stanford University Publications, University Series, p. 28.

1916. *Haemodipsus lyriocephalus* (Burmeister), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 151.

1929. *Haemodipsus lyriocephalus* (Burmeister), Ewing, *Manual of External Parasites*, p. 140.

PREVIOUS RECORDS. Apparently known only from *Lepus timidus* in Europe.

SPECIMENS EXAMINED. Three adult females and several immature specimens in the Piaget Collection (British Museum) from *Lepus timidus* and "sur un lièvre" and two females from *Lepus glacialis*, without indication of locality (Molteno Institute).

FEMALE (Fig. 202). Length 2.5 mm. *Head* (Fig. 203 *B*) elongate, almost cylindrical, slightly pointed anteriorly, without post-antennal or

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occipital angles, the lateral margins of the hind head but little convex and with a narrow, longitudinal, sclerotic area; supporting framework of the mouth parts (Fig. 203 *D*) large and conspicuous. *Thorax* relatively small,

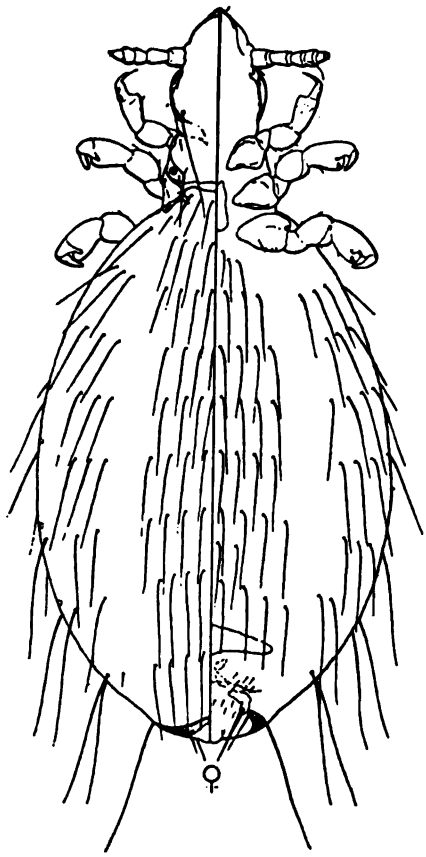

FIG. 202.—*Haemodipsus lyriocephalus* (Burmeister), female, from specimen from *Lepus timidus* (Piaget Collection).

shorter than the head and but little wider, cylindrical, the notum (Fig. 203 *C*) suppressed, the mesothoracic pleurites connecting across the dorsum; sternal plate present as an ill-defined, slightly elongate sclerotic area. *Legs* relatively small, the middle and posterior pairs not strongly flattened.

Abdomen oval, membranous throughout, without the slightest trace of paratergites (= pleurites). Setae numerous, slender, arranged both dorsally and ventrally in median and lateral groups. *Genital region* (Fig. 203 *A*) with a conspicuous, narrow, transverse genital plate; gonopophyses practically obsolete, their positions marked chiefly by a row of small setae;

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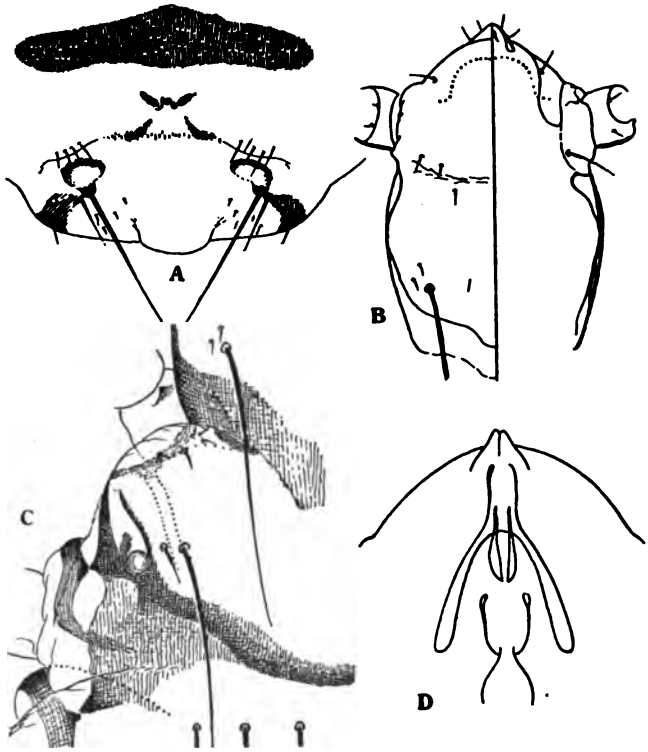

FIG. 203.—*Haemodipsus lyriocephalus* (Burmeister): *A*, genital region; *B*, head; *C*, dorsum of thorax; *D*, outlines of portions of mouth parts.

apical angles of the ninth sternite with a tubercle bearing a single long seta.

NOTES.—The form of the head and the entire absence of paratergites distinguish this species sharply from others of the genus. In general character it resembles some of the species of *Linognathus*, but in all the members of the latter genus the gonopophyses are strongly developed.

2. Haemodipsus ventricosus (Denny)

FIGS. 204, 205 *A, C, D, F, G*

1842. *Haematopinus ventricosus* Denny, *Monographia Anoplurorum Britanniae*, p. 30; pl. 25, fig. 6.
1874. *Haematopinus ventricosus* Denny, Giebel, *Insecta Epizoa*, p. 47.
1880. *Haematopinus ventricosus* Denny, Piaget, *Les Pediculines*, p. 642.
1896. *Haematopinus ventricosus* Denny, Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (new series), 5: 182. (Possibly in part a misidentification; see *H. setoni* Ewing.)

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1904. *Haemodipsus ventricosus* (Denny), Enderlein, *Zoologischer Anseiger*, **28**: 143.
1908. *Haemodipsus ventricosus* (Denny), Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 15.
1909. *Haematopinus* (*Polyplax*) *ventricosus* (Denny), Neumann, *Archives de Parasitologie*, **13**: 527–528; fig. 27.
1910. *Haemodipsus ventricosus* (Denny), Mjöberg, *Arkiv för Zoologi*, **6**: 13: 165.

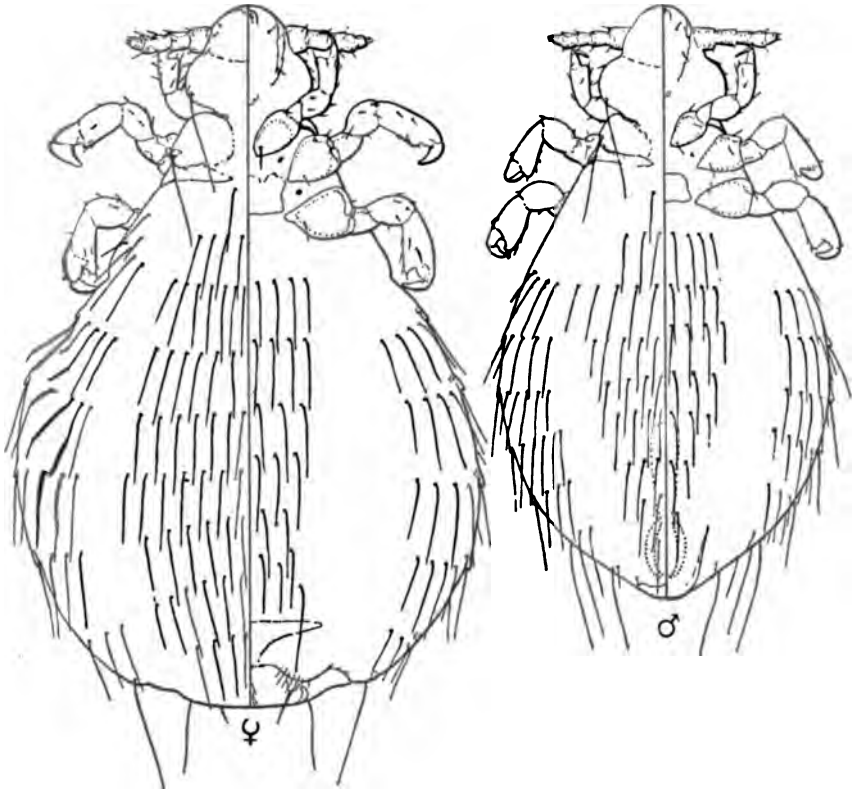

FIG. 204.—*Haemodipsus ventricosus* (Denny), male and female. From specimens from *Oryctolagus cuniculus* (British Museum).

1913. *Polyplax ventricosa* (Denny) Evans, *Proceedings Royal Physical Society Edinburgh*, **19**: 94.
1913. *Haemodipsus ventricosus* (Denny), Johnston and Harrison, *Proceedings of the Royal Society of Queensland*, **24**: 107.
1915. *Haemodipsus ventricosus* (Denny), Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals*, Stanford University Publications, University Series, p. 28. (Part; part misidentification; see *H. setoni* Ewing.)
1916. *Haemodipsus ventricosus* (Denny), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), **6**: 152. (Part; part misidentification; see *H. setoni* Ewing.)

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1924. *Haemodipsus ventricosus* (Denny), Ewing, *American Journal of Tropical Medicine*, 4: 550.

1929. *Haemodipsus ventricosus* (Denny), Ewing, *Manual of External Parasites*, p. 140.

NOTE.—References in medical journals having to do with this species and its significance as a vector in the transmission of tularemia are omitted from this bibliography.

PREVIOUS RECORDS. Many times recorded from the European rabbit, *Lepus cuniculus*, and from "domestic" rabbits. Neumann has recorded it also from *Lepus timidus*, although possibly erroneously. Records of it from native rabbits and hares in the United States are erroneous and refer to *H. setoni* Ewing.

SPECIMENS EXAMINED. From *Oryctolagus cuniculus* without indication of locality (British Museum) and Victoria, Australia (Stanford Collection); "Belgian hare," Dallas, Texas (Bishop), and Knoxville, Tennessee (Stanford Collection).

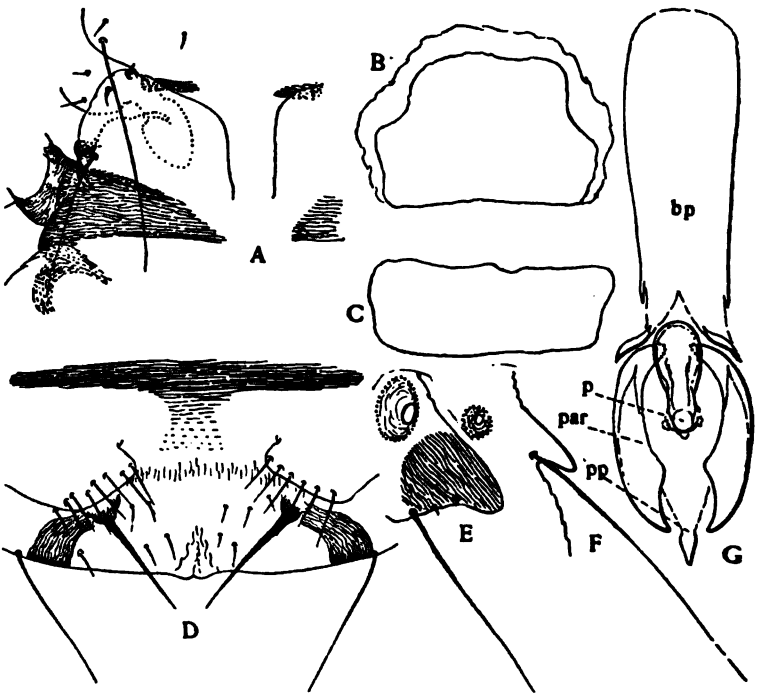

FIG. 205.—*Haemodipsus ventricosus* (Denny): *A*, dorsum of thorax; *C*, sternal plate; *D*, genital region of female; *F*, paratergite; *G*, genitalia of male. *Haemodipsus setoni* Ewing: *B*, sternal plate; *E*, paratergite; from specimen from *Lepus californicus*, California.

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FEMALE (Fig. 204). Length 1.5 mm. *Head* of a very distinctive form, relatively small and somewhat deflexed, the fore head rounded, the lateral margins of the hind head strongly swollen, each forming almost a sector of a circle, the occipital region forming a neck; lateral margins of the hind head without a sclerotic area.

Thorax shorter than the head and scarcely one and a half times as wide, the lateral margins revolute toward the ventral side, the condyles of the coxae (Fig. 205 *A*) thus being concealed; sclerotic transverse bands of the pleurites not uniting across the dorsum; sternal plate (Fig. 205 *C*) somewhat irregular and variable, but typically narrow and transverse, its margins not free. *Legs* of the form typical for the genus.

Abdomen of a characteristic, pyriform configuration; setae slender, arranged both dorsally and ventrally into median and marginal groups; paratergites present on the third to sixth segments, exceedingly minute, forming merely a slight tooth (Fig. 205 *F*) which bears a long seta at its base. Spiracles small. *Genital region* (Fig. 205 *D*) with a narrow, transverse genital plate; gonopophyses slightly more strongly developed than in *H. lyriocephalus;* apical angles of ninth segment each with a long, stout seta.

MALE (Fig. 204). Length 1 mm. Closely resembling the female, but body somewhat less pyriform. *Genitalia* (Fig. 205 *G*) of a simple type, the basal plate (*bp*) broad, its apex articulating with the stout, curved parameres (*par*), which inclose between their apices the very small, wedge-shaped pseudopenis (*pp*) and between their bases the quite large penis (*p*).

NOTES.—The writer agrees with Ewing's conclusion that specimens from American "jack rabbits" are distinct from *H. ventricosus.* The differences will be discussed in connection with the latter species.

3. Haemodipsus setoni Ewing

FIG. 205 *B, E*

1896. *Haematopinus ventricosus* (Denny), Osborn, *United States Department of Agriculture, Division of Entomology Bulletin* (new series), 5: 182. (Probably in part.)

1915. *Haemodipsus ventricosus* (Denny), Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, pp. 28–30; t. fig. 11; pl. 2, fig. 2; pl. 4, fig. 5; pl. 5, fig. 12. (Misidentification.)

1916. *Haemodipsus ventricosus* (Denny), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 152. (Part; misidentification.)

1924. *Haemodipsus setoni* Ewing, *American Journal of Tropical Medicine,* 4: 548–549.

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PREVIOUS RECORDS. It is very probable that specimens recorded by Osborn from *Lepus campestris* in Iowa as *H. ventricosus* are this species. Those recorded by Kellogg and Ferris and by Ferris from *Lepus californicus* in California and Arizona are certainly so. Recorded by Ewing as *H. setoni* from *Lepus californicus melanotis,* Wichita, Kansas, and *L. californicus californicus,* San Diego, California.

SPECIMENS EXAMINED. Those upon which the previous records by Kellogg and Ferris and by Ferris were based, and others from *Lepus glacialis,* without indication of locality (Molteno Institute).

NOTES.—This species is so very similar to *H. ventricosus* that comparative notes only will be given. It differs in the relatively much larger head and in having the lateral margins of the hind head perhaps less swollen than in *ventricosus.* The hind head is relatively somewhat longer than in *ventricosus,* although the character utilized by Ewing, "temporal region of head about as broad as long," appears to the writer to be illusory. The sternal plate of the thorax is definitely larger than in *ventricosus* and of a somewhat hexagonal form instead of being transverse (Fig. 205 *B*). The *abdomen* is oval rather than pyriform and the paratergites (Fig. 205 *E*) are larger and better developed than in *ventricosus.* It is noticeably larger than *ventricosus,* specimens from the type host attaining 1.8 mm. for the female and 1.5 mm. for the male, while those from *Lepus glacialis* attain 2 mm. for the female.

The differences between *H. ventricosus* and *H. setoni* are thus slight, but they appear to be significant and the recognition of *H. setoni* appears to be justified.

Genus **LINOGNATHUS** Enderlein

1904. *Trichaulus* Enderlein, *Zoologischer Anzeiger,* **28**: 139, 141. (Preoccupied.)
1905. *Linognathus* Enderlein, *ibid.,* **29**: 194.
1908. *Linognathus,* Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 12.
1909. *Haematopinus* (*Linognathus*), Neumann, *Archives de Parasitologie,* **13**: 529–530.
1910. *Linognathus,* Mjöberg, *Arkiv för Zoologi,* **6**: 156.
1913. *Linognathus,* Patton and Cragg, *Textbook of Medical Entomology,* p. 544.
1915. *Linognathus,* Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 10.
1916. *Linognathus,* Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 159. (Part.)
1929. *Linognathus,* Ewing, *Manual of External Parasites,* pp. 136, 138.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; occiput produced into the thorax; the anterior legs normally (in all but one species) with tibia and tarsus separate and with slender claw, the middle and posterior legs with tibia and tarsus fused, enlarged and with broad, heavy claw; paratergal plates always entirely lacking; spiracles present on third to eighth abdominal segments, more or less globular and not borne within sclerotic tubercles; tergal and sternal plates lacking except for the usual ninth tergite in the female and various

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plates in the genital region of both sexes; derm of the abdomen normally membranous throughout and more or less squamate-reticulate, sometimes slightly sclerotic and pigmented; abdominal setae arranged usually in a characteristic pattern, the majority of the segments, both dorsally and ventrally, with one transverse row and with a second row represented by a medium group, the margins of at least the seventh and eighth segments with long slender setae, the pattern of setae, however, sometimes obscured by an increase in the number; thorax with the pleurites, which constitute the greater part of the apparent dorsum, not united across the meson; gonopophyses present, their apices free; spermatheca present, its opening into the uterus marked by a sclerotic scar; apex of the abdomen of the female ventrally with a pair of non-sclerotic lobes; genitalia of the male of a rather constant type, the parameres and pseudopenis and usually a ring-like endomeral piece present; genital plate of the male not lyriform (except in one species).

HOSTS. With the exception of a single species, which occurs on members of the family Canidae of the Order Carnivora, all the known species are from members of the ungulate Order Artiodactyla. Within this Order the hosts, with the single exception of one species of the family Giraffidae, are members of the family Bovidae, the cattle, sheep, goats, antelopes, and similar forms. The genus may, in fact, be regarded as characteristic of this family.

TYPE OF THE GENUS. *Pediculus setosus* Olfers (= *Pediculus piliferus* Burmeister).

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS

NOTE.—Names in italics are synonyms of the name with which they are coupled.

africanus Kellogg and Paine.
    Linognathus stenopsis (Burmeister) (part, misidentification).
angulatus (Piaget).
    Haematopinus angulatus Piaget.
    Haematopinus ungulatus Piaget (misprint).
    Linognathus ungulatus (Piaget).
angulatus (Piaget) (misidentification).
    Linognathus gazella Mjöberg.
antennatus (Piaget).
    Linognathus tibialis (Piaget).
appendiculatus (Piaget).
    Linognathus tibialis (Piaget).
binipilosus Fahrenholz.
    Solenopotes binipilosus (Fahrenholz).
breviceps (Piaget).
    Haematopinus breviceps Piaget.

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brevicornis (Giebel).
Haematopinus brevicornis Giebel.
Trichaulus brevicornis (Giebel).
burmeisteri Fahrenholz.
Solenopotes burmeisteri (Fahrenholz).
capillatus (Enderlein).
Solenopotes capillatus Enderlein.
caviae-capensis (Pallas).
Prolinognathus caviae-capensis (Cummings).
cervicaprae (Lucas).
Haematopinus cervicaprae Lucas.
Haematopinus tibialis var. *cervicaprae* Lucas.
Linognathus tibialis var. *cervicaprae* (Lucas).
coassus Fahrenholz.
Solenopotes binipilosus (Fahrenholz).
crassicornis (Nitzsch).
Solenopotes burmeisteri (Fahrenholz).
euchore Waterston.
Linognathus tibialis (Piaget).
fahrenholzi Paine.
Linognathus forficula Kellogg and Paine (not *forficulus* Rudow).
forficula Kellogg and Paine (not *forficulus* Rudow).
Linognathus fahrenholzi Paine.
forficulus (Rudow).
Linognathus stenopsis (Burmeister).
ferrisi Fahrenholz.
Solenopotes ferrisi (Fahrenholz).
ferrisi Bedford (not of Fahrenholz).
Linognathus gnu Bedford.
gazella Mjöberg.
Linognathus angulatus (Piaget) (misidentification).
Linognathus gilvus Fahrenholz.
gilvus Fahrenholz.
Linognathus gazella Fahrenholz.
gnu Bedford.
Linognathus ferrisi Bedford (not of Fahrenholz).
Linognathus gorgonus Bedford.
gorgonus Bedford.
Linognathus gnu Bedford.
leptocephalus (Ehrenberg).
Prolinognathus leptocephalus (Ehrenberg).
limnotragi Cummings.
microcephalus (Garnett).
Linognathus pedalis (Osborn).
oviformis (Rudow).
ovillus (Neumann).
Haematopinus ovillus Neumann.
ovillus (Neumann) (part, misidentification).
Linognathus pedalis (Osborn).

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panamensis Ewing.
Solenopotes binipilosus (Fahrenholz).
pedalis (Osborn).
Haematopinus microcephalus Garnett.
Haematopinus pedalis Osborn.
Linognathus microcephalus (Garnett).
Linognathus ovillus (Neumann) (part, misidentification).
piliferus (Burmeister).
Linognathus setosus (Olfers).
pithodes Cummings.
praelongiceps (Neumann).
Microthoracius praelongiceps (Neumann).
rupicaprae (Rudow).
Linognathus stenopsis (Burmeister).
saccatus (Gervais).
Haematopinus saccatus Gervais.
Trichaulus saccatus (Gervais).
schistopygus (Nitzsch).
Linognathus stenopsis (Burmeister).
setosus (Olfers).
Haematopinus bicolor Lucas.
Haematopinus piliferus (Burmeister).
Linognathus piliferus (Burmeister).
Pediculus flavidus Nitzsch.
Pediculus isopus Nitzsch.
Pediculus piliferus Burmeister.
Pediculus setosus Olfers.
Trichaulus piliferus (Burmeister).
stenopsis (Burmeister).
Haematopinus forficulus Rudow.
Haematopinus rupicaprae (Rudow).
Haematopinus stenopsis (Burmeister).
Linognathus forficulus (Rudow).
Linognathus rupicaprae (Rudow).
Linognathus schistopygus (Nitzsch).
Pediculus stenopsis Burmeister.
Trichaulus stenopsis (Burmeister).
taurotragus Bedford.
tibialis (Piaget).
Haematopinus tibialis (Piaget).
Haematopinus tibialis var. *antennatus* Piaget.
Haematopinus tibialis var. *appendiculatus* Piaget.
Linognathus tibialis var. *euchore* Waterston.
tibialis var. *antennatus* (Piaget).
Linognathus tibialis (Piaget).
tibialis var. *appendiculatus* (Piaget).
tibialis var. *cervicaprae* (Lucas).
Linognathus cervicaprae (Lucas).
tibialis var. *euchore* Waterston.
Linognathus tibialis (Piaget).

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vituli (Linnaeus).

Haematopinus tenuirostris (Burmeister).
Haematopinus vituli (Linnaeus).
Pediculus oxyrrhynchus Nitzsch.
Pediculus tenuirostris Burmeister.
Pediculus vituli Linnaeus.
Trichaulus vituli (Linnaeus).

NOTES.—This genus as herein understood constitutes a very homogeneous group, the only discordant element being formed by *L. spicatus* n. sp. Even here, while this particular species if taken by itself departs rather widely from the typical form, there are sufficient connecting links to show that we have to do merely with exaggerated specific characters. To remove this single species from *Linognathus* because of its peculiarities would be to separate it from those species to which it is obviously closely related.

It is unfortunate that *L. setosus* (Olfers), chosen by Enderlein for the type of the genus, is not an entirely typical member of the group, being an extreme form both in structure and in its host connections and thus offering the danger that authors with a tendency to multiply genera will seize upon its differences for further splitting and consequent nomenclatorial changes. However, with the removal of certain species which have previously been referred to *Linognathus*, it is the writer's view that further subdivision, other than subgeneric, should be avoided.

As here understood, this genus contains twenty-three species of which all but three have been seen by the writer. One species will probably forever stand as unrecognizable; the other two may possibly sometime be recognized. The known species may be divided into three or four fairly well-defined groups, which do not, however, seem to the writer to demand recognition in the formal nomenclature at the present time.

1. Linognathus setosus (Olfers)

FIGS. 206; 207 *A, C, F, G;* 216 *E*

1816. *Pediculus setosus* Olfers, *"De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius."*
1838. *Pediculus piliferus* Burmeister, *Genera Insectorum, Rhynchota,* Species 13.
1842. *Haematopinus piliferus* (Burmeister), Denny, *Monographia Anoplurorum Britanniae,* p. 28; pl. 25, fig. 4.
1843. *Haematopinus piliferus* (Burmeister), Gurlt, *Magazin für die gesamte Tierheilkunde,* 9: 9; pl. 7.
1847. *Haematopinus bicolor* Lucas, *Annales de la Société Entomologique de France,* (2), 5: 538; pl. 9, fig. 2*a*.
1861. *Pediculus isopus* Nitzsch, *Zeitschrift für die gesamten Naturwissenschaften,* 18: 290.
1864. *Pediculus flavidus* Nitzsch, *ibid.,* 23: 27.
1874. *Haematopinus piliferus* (Burmeister), Giebel, *Insecta Epizoa,* p. 40.
1880. *Haematopinus piliferus* (Burmeister), Piaget, *Les Pediculines,* p. 643; pl. 52, fig. 6.
1891. *Haematopinus piliferus* (Burmeister), Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (old series), 7: 11; fig. 5.
1896. *Haematopinus piliferus* (Burmeister), Osborn, *ibid., Bulletin* (new series), 5: 169; fig. 98.

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1904. *Trichaulus piliferus* (Burmeister), Enderlein, *Zoologischer Anseiger,* **28**: 142.
1905. *Linognathus piliferus* (Burmeister), Enderlein, *ibid.,* **29**: 194.
1908. *Linognathus piliferus* (Burmeister), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 12.
1910. *Linognathus piliferus* (Burmeister), Mjöberg, *Arkiv för Zoologi,* **6**: 157; fig. 77.
1915. *Linognathus piliferus* (Burmeister), Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 11.
1916. *Linognathus piliferus* (Burmeister), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 164.
1916. *Linognathus setosus* (Olfers), Ferris, *ibid.,* p. 205. (Fide L. Harrison.)
1919. *Linognathus setosus* (Olfers), Ferris, *Report of the Canadian Arctic Expedition,* **3**: Part D: 11.
1919. *Linognathus setosus* (Olfers), Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover,* **5–10**: 23.
1924. *Linognathus piliferus* (Burmeister), Ewing, *American Journal of Tropical Medicine,* **4**: 547–551.
1925. *Haematopinus* (*Linognathus*) *piliferus* (Burmeister), Hall, *United States Department of Agriculture,* Circular 338.
1929. *Linognathus piliferus* (Burmeister), Ewing, *Manual of External Parasites,* p. 139; fig. 75.

Previous Records. Normally a parasite of the domestic dog, from which it has been recorded in many parts of the world; recorded by Denny from a ferret; by Ferris from "white fox," *Alopex lagopus innuitus,* from Alaska and from "captive fox" in the United States; recorded by Ewing from these hosts, from "coyote," *Canis* sp., and from rabbits.

Specimens Examined. From domestic dogs in various localities, Cambridge (Molteno Institute) and Wimbledon (British Museum), England; Misantla, Mexico (British Museum); Palo Alto, California (Stanford University); Swan Island, Panama Canal Zone, *L. H. Dunn* (Stanford University). From *Canis cupus,* Kriviput, Croatia (British Museum). From "fox" and "Arctic fox," presumably *Alopex lagopus,* "Arctic regions, Dr. McCormick" (British Museum); Flakman Island, Alaska, II, 1910 (British Museum); Coronation Gulf, Canada, 1926 (British Museum). From "Blue fox," Alaska, *Bishopp,* and *Vulpes fulva,* in captivity, Washington, D.C., *E. A. Chapin* (Stanford University).

Female (Fig. 206). Length, on slide, 2 mm. *Head* (Fig. 207 *F*) short and broad, the fore head rather trapezoidal, the antennae arising from about the middle of the head; fore head with a strong, heavily pigmented, transverse band, both dorsally and ventrally; antennae quite short and stout; mouth parts barely exceeding the posterior border of the head; pharynx without brushes (Fig. 216 *E*).

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Thorax of the form normal to the genus, not sclerotic, except for t[illegible] transverse bands; with a slight tendency toward the development of a fr[illegible] lobe in the posterior lateral angles; sternal plate lacking; spiracles u[illegible] usually large.

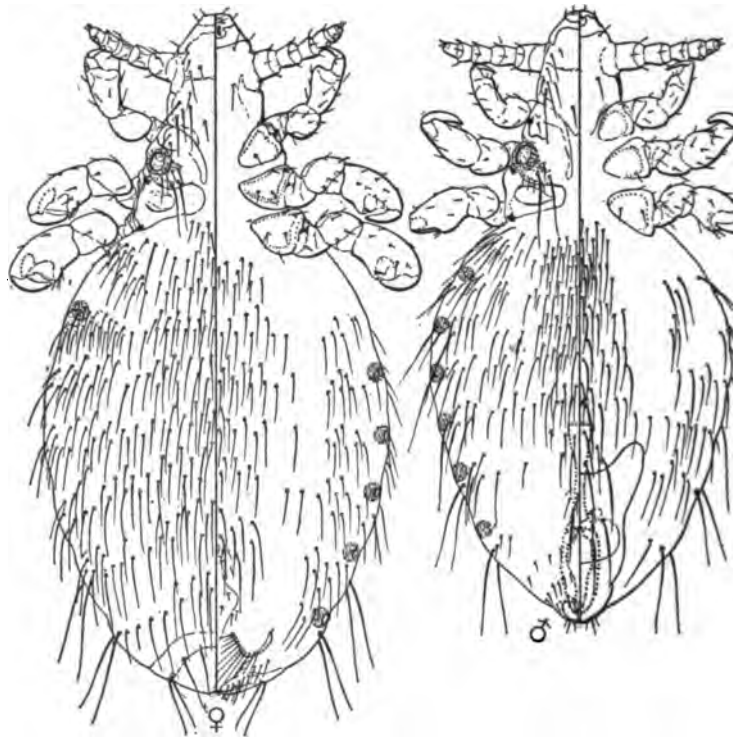

FIG. 206.—*Linognathus setosus* (Olfers), male and female.

Abdomen broadly oval, thickly beset with slender setae, the arrangement of rows being obscured by the numbers on the dorsal side, the ventral side somewhat less hairy and with a bare, longitudinal area on each side; margins with long setae on the seventh and eighth segments and sometimes on other segments as well; spiracles (Fig. 207 *C*) strikingly large. *Gonopophyses* (Fig. 207 *G*) short and broad, the posterior margin broadly rounded and beset with a row of moderately large setae; slightly or not at all sclerotic except for a narrow longitudinal area; median genital plate relatively small; a tuft of small setae between each gonopod and the corresponding apical lobe, the latter small and inconspicuous and terminating in a sclerotic spine (Fig. 207 *G*).

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MALE (Fig. 206). Resembling the female except for the smaller and more pointed abdomen. Length 1.5 mm. Abdomen somewhat less hairy than in the female, the dorsal side almost without setae posteriorly of the sixth segment. Genital plate strongly developed, somewhat shield-shaped.

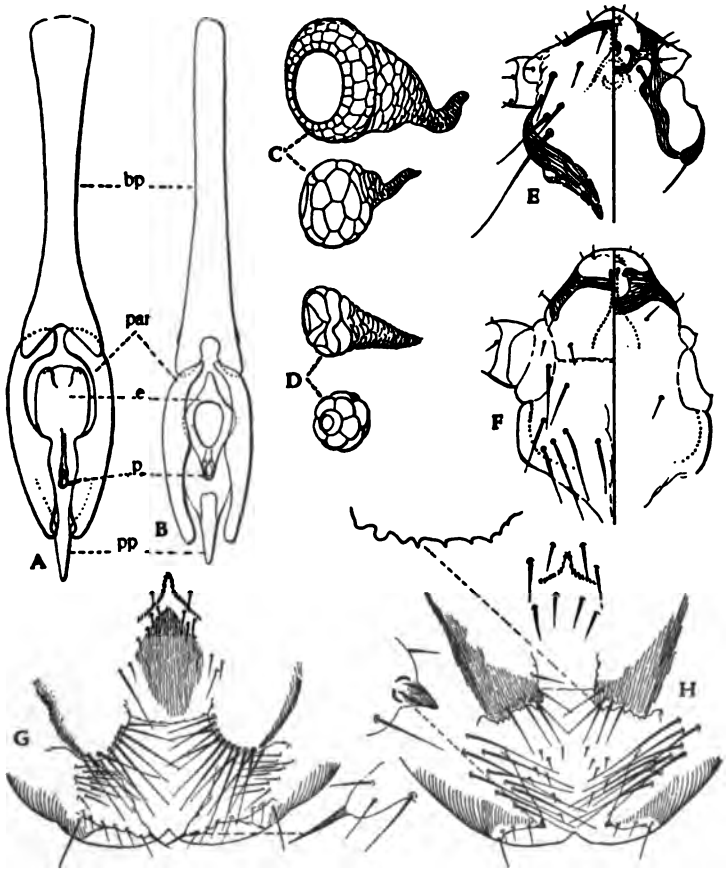

FIG. 207.—*Linognathus setosus* (Olfers): *A*, genitalia of male; *C*, thoracic and abdominal spiracles; *F*, head; *G*, genital region of female. *Linognathus pedalis* (Osborn): *B*, genitalia of male; *D*, thoracic and abdominal spiracles; *E*, head; *H*, genital region of female.

Genitalia (Fig. 207 *A*) marked chiefly by the form of the endomeral piece (*e*), which here constitutes a flattened, elongate plate and not a ring-like structure such as appears in most of the species of the group.

NOTES.—In its very short and broad head and very hairy body this species departs from the characteristics of most of the species of the genus, but it does not appear

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that the differences are anything more than specific. Its occurrence upon carnivores is peculiar, for it is the only known species of sucking lice that occurs normally on hosts of this order. What is apparently its nearest relative, *L. pedalis* (Osborn), occurs upon sheep. It is difficult to avoid the speculative assumption that the long association of dogs and sheep has something to do with this anomalous condition, especially as the domestic dogs appear to have accumulated their ectoparasites from various sources. However, the occurrence of *L. setosus* upon foxes in the Arctic regions greatly disturbs the satisfaction to be obtained from such a hypothesis.

The two species, *L. setosus* and *L. pedalis*, are readily separable by a number of distinct characters, such as the form of the gonopophyses, of the genitalia of the males, and of the head. The specimens of *L. setosus* vary somewhat in the size of the spiracles, although in all these are strikingly large; but there seems to be no adequate ground for any subdivision of the species on this basis.

2. Linognathus pedalis (Osborn)

FIGS. 207 *B, D, E, H;* 208

1896. *Haematopinus pedalis* Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (new series), 5: 170; fig. 99.
1896. *Haematopinus ovis* Lugger, *Report of the Entomologist, State Experiment Station, Minnesota,* p. 105; figs. 75–76.
1904. *Trichaulus pedalis* (Osborn), Enderlein, *Zoologischer Anzeiger,* 28: 142.
1905. *Linognathus pedalis* (Osborn), Enderlein, *ibid.,* 29: 194.
1908. *Linognathus pedalis* (Osborn), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 12.
1911. *Haematopinus microcephalus* Garnett, *Journal of Comparative Pathology and Therapeutics,* p. 2; figs. 1–2.
1915. *Linognathus pedalis* (Osborn), Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 11.
1916. *Linognathus pedalis* (Osborn), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 162, 205.
1919. *Linognathus pedalis* (Osborn), Hopkirk, *New Zealand Journal of Agriculture,* 19: 15.
1920. *Linognathus pedalis* (Osborn), Hall, *United States Department of Agriculture, Farmers' Bulletin 1150.*
1922. *Linognathus pedalis* (Osborn), Froggatt, *Agricultural Gazette of New South Wales,* 33: 718.
1922. *Haematopinus pedalis* Osborn, Mote, *Ohio Agricultural Experiment Station Bulletin 356.*
1925. *Linognathus pedalis* (Osborn), Newman, *Journal of the Department of Agriculture of West Australia,* (2), 2: 9; figs.
1927. *Linognathus pedalis* (Osborn), Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report,* 11–12: 737.

PREVIOUS RECORDS. Recorded only from domestic sheep; United States, South America, New Zealand, Australia, and South Africa.

SPECIMENS EXAMINED. From domestic sheep; Tennessee and California, U.S.A. (Stanford University); Pietermaritzburg, Natal, South

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Africa, *L. Hill* (Stanford University); Bathurst, New South Wales, Australia (Imperial Bureau of Entomology).

FEMALE (Fig. 208). Length, on slide, 2 mm. *Head* (Fig. 207 *E*) very small and short, with the antennae placed close to the broadly conical anterior margin; fore head dorsally with a narrow, transverse sclerotic band which is continuous with a narrow, transverse ventral band and a narrow, longitudinal ventral band that connects with the sclerotic marginal band of the hind head; pharynx apparently without brushes, mouth parts scarcely exceeding the posterior margin of the head.

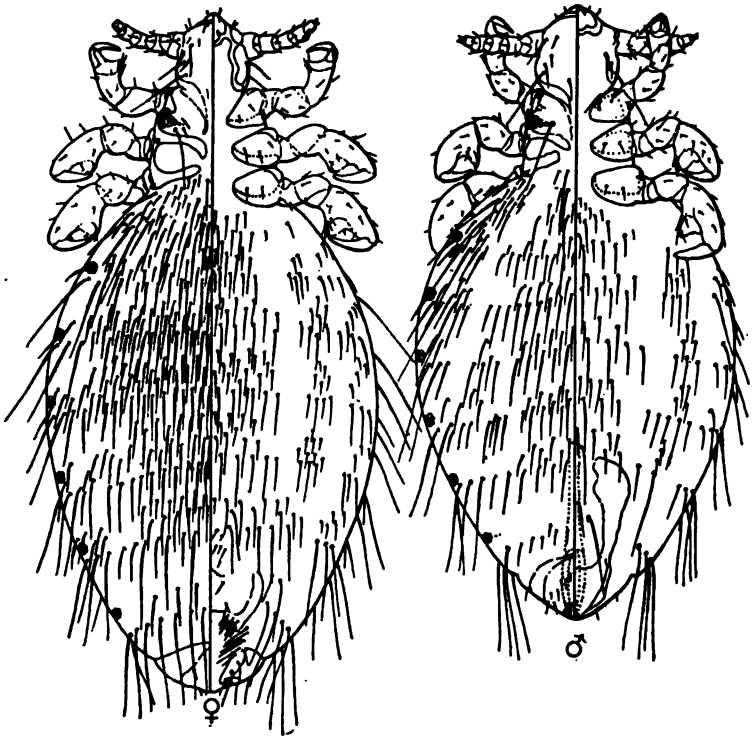

FIG. 208.—*Linognathus pedalis* (Osborn), male and female. From specimens from Texas, U.S.A.

Thorax relatively very small, the transverse bands strongly sclerotic, the remainder membranous; sternal plate lacking; posterior lateral angles without a free lobe.

Abdomen elongate oval, very thickly beset dorsally with quite long, slender setae, the arrangement of rows being obscured; ventral side with the setae fewer and arranged in longitudinal bands; *spiracles* (Fig. 207 *D*)

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relatively very small. *Gonopophyses* (Fig. 207 *H*) broadly truncate, with the apex more or less serrate and bearing but a few small setae; median genital plate lacking; a cluster of moderately long setae in the space between the gonopods and the short, inconspicuous apical lobes which terminate in a blunt point.

MALE (Fig. 208). Length, on slide, 1.5–1.75 mm. Very similar to the female except for the more pointed and somewhat less hairy abdomen. *Genitalia* (Fig. 207 *B*) with the parameres (*par*) blunt at the tip, the endomeral piece (*e*) forming a distinct ring; genital plate of distinctive form, being composed of two arms which are connected only at the apex of the body.

NOTE.—This species seems obviously to be rather closely related to *L. setosus* (Olfers), as pointed out in connection with the latter, but the characters given separate the two with no possibility of doubt.

3. Linognathus ovillus (Neumann)

FIGS. 209, 210 *A, B, C, E*

1907. *Haematopinus ovillus* Neumann, *Revue vétérinaire,* 32:520; t. fig.
1913. *Linognathus ovillus* (Neumann), Evans, *Proceedings of the Royal Physical Society of Edinburgh,* 19: 94.
1913. *Linognathus ovillus* (Neumann), Johnston and Harrison, *Proceedings of the Royal Society of Queensland,* 24: 107.
1916. *Linognathus ovillus* (Neumann), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 162.
1920. *Haematopinus ovillus* Neumann, Hall, *United States Department of Agriculture, Farmers' Bulletin 1150.*
1922. *Haematopinus ovillus* Neumann, Froggatt, *Agricultural Gazette of New South Wales,* 33: 718.
1923. *Haematopinus ovillus* Neumann, Patten, *ibid.,* 34: 241.
1924. *Linognathus (Haematopinus) ovillus* (Neumann), Foley and Meslin, *Archives de l'Institute Pasteur d'Algérie,* Vol. 2.
1925. *Linognathus ovillus* (Neumann), Kolosov, *Bulletin of the Entomological and Phytopathological Bureau, Ural Society of Naturalists,* 2: 5.
1928. *Linognathus (Haematopinus) ovillus* (Neumann), Imes, *United States Department of Agriculture, Leaflet No. 13.*

PREVIOUS RECORDS. Originally described from domestic sheep from New Zealand and Scotland, these records alone are to be accepted as authentic. The records by later authors, from Australia, the United States, and Russia, on domestic sheep and from *Ovis longipes* in Algeria are dubious.

SPECIMENS EXAMINED. From sheep in New Zealand and Australia, slides from the Neumann Collection, undoubtedly including the types, received as a loan through the kindness of Professor A. Martin of the École Vetérinaire de Toulouse. From sheep, Falkland Islands (British

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Museum). From sheep, New South Wales, received from Imperial Bureau of Entomology for identification (1931).

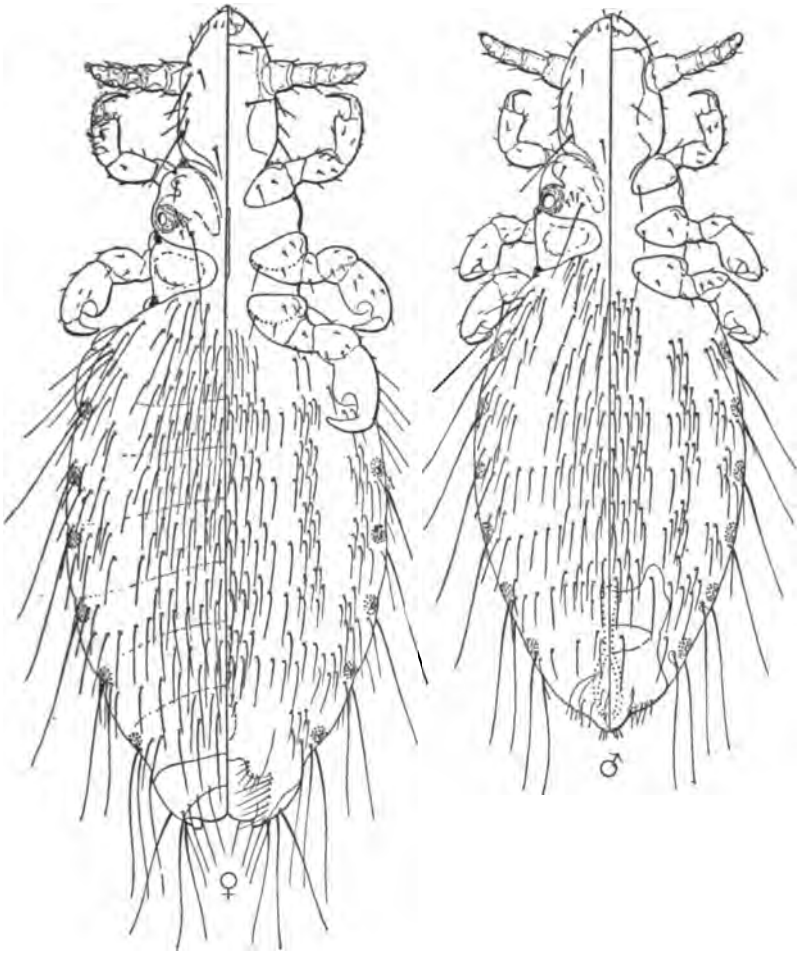

FIG. 209.—*Linognathus ovillus* (Neumann), male and female. From the types.

FEMALE (Fig. 209). Length 2.5 mm. *Head* (Fig. 210 *B*) relatively large, broad, the fore head quite sharply parabolic, the antennae set well forward, the hind head with the sides nearly parallel, but slightly convex; fore head with a transverse band on the ventral side, the hind head with rather weak lateral sclerotic areas; pharynx with distinct brushes.

Thorax about as long as the head, relatively narrow, the sides nearly parallel; sternal plate very small and slender or lacking; dorsum but slightly sclerotic.

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Abdomen very hairy, the hairs in two fairly well defined rows on the dorsum, with a longitudinal bare area on each side and clusters of setae near the margins which bear also one or more very long setae on each segment; venter with two longitudinal bare strips on each side, thus leaving a cluster of setae between the marginal and median groups. *Spiracles* (Fig. 210 *C*) noticeably large and conspicuous. *Gonopophyses* (Fig. 210 *E*) rather small, broadly rounded at the apex and bearing a number of moderately large hairs; genital plate very small, not reaching the vulva; apical lobes small, bearing three or four long and several small setae and with a very small, stout seta at the apex.

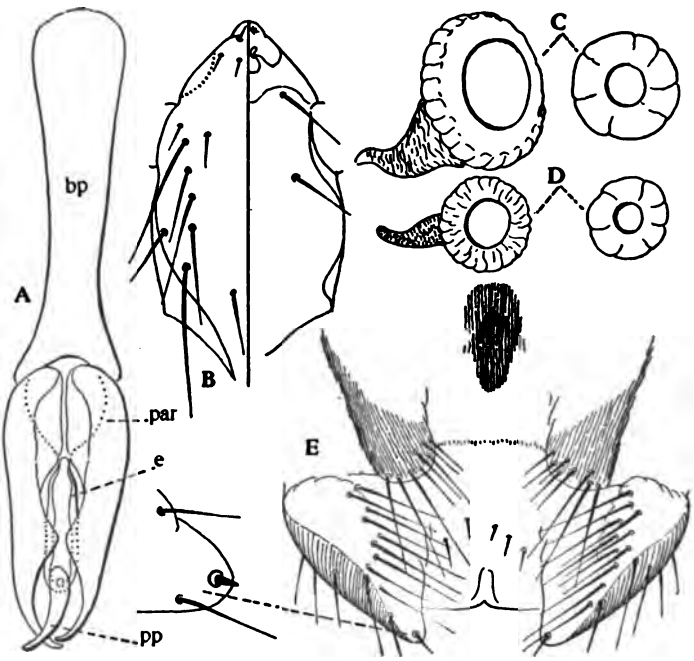

FIG. 210.—*Linognathus ovillus* (Neumann): *A*, genitalia of male; *B*, head; *C*, thoracic and abdominal spiracles; *E*, genital region of female. *Linognathus stenopsis* (Burmeister): *D*, thoracic and abdominal spiracles.

MALE (Fig. 209). Length, 2.25 mm. In general similar to the female, but slightly less hairy. *Genitalia* (Fig. 210 *A*) with the parameres (*par*) strongly curved and acute at the apex and with the endomeral piece (*e*) forming an elongate ring; apex of the abdomen forming a slight point.

NOTES.—This species may well be considered here in connection with *L. setosus* and *L. pedalis*, to which it bears some slight resemblance in the hairiness of the body,

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and in connection with the other species from sheep and goats, which will next be discussed. The broad head, the strikingly large spiracles, and the genitalia of the female distinguish it readily from any of the associated species.

4. Linognathus stenopsis (Burmeister)

FIGS. 210 *D;* 211; 212 *A, C, D, F*

NOTE.—Owing to the fact that two species occur upon goats, there has been confusion in the literature and it is possible that not all of the references here cited actually refer to *L. stenopsis,* this name having commonly been employed for any sucking louse on goats.

1838. *Pediculus stenopsis* Burmeister, *Genera Insectorum, Rhynchota,* Species 3.
1842. *Haematopinus stenopsis* (Burmeister), Denny, *Monographia Anoplurorum Britanniae,* p. 36.
1864. *Pediculus stenopsis* Burmeister, Nitzsch, *Zeitschrift für die gesamten Naturwissenschaften,* 23: 30.
1864. *Pediculus schistopygus* Nitzsch, *ibid.,* 23: 31.
1869. *Haematopinus forficulus* Rudow, *ibid.,* 34: 169.
1869. *Haematopinus rupicaprae* Rudow, *ibid.,* 34: 170.
1874. *Haematopinus stenopsis* (Nitzsch), Giebel, *Insecta Epizoa,* p. 44; pl. 2, fig. 4.
1874. *Haematopinus forficulus* Rudow, Giebel, *ibid.,* p. 47.
1874. *Haematopinus rupicaprae* Rudow, Giebel, *ibid.,* p. 47.
1880. *Haematopinus stenopsis* (Burmeister), Piaget, *Les Pediculines,* p. 648.
1891. *Haematopinus stenopsis* (Burmeister), Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (old series), 7: 12.
1896. *Haematopinus stenopsis* (Burmeister), Osborn, *ibid., Bulletin* (new series), 5: 170.
1904. *Trichaulus stenopsis* (Burmeister), Enderlein, *Zoologischer Anzeiger,* 28: 142.
1905. *Linognathus stenopsis* (Burmeister), Enderlein, *ibid.,* 29: 194.
1908. *Linognathus stenopsis* (Burmeister), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 12.
1908. *Haematopinus forficulus* Rudow, Dalla Torre, *ibid.,* p. 11.
1908. *Haematopinus rupicaprae* Rudow, Dalla Torre, *ibid.,* p. 11.
1910. *Linognathus stenopsis* (Burmeister), Mjöberg, *Arkiv för Zoologi,* 6: 159.
1915. *Linognathus stenopsis* (Burmeister), Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 11.
1916. *Linognathus stenopsis* (Burmeister), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 164. (Part.)
1916. *Linognathus forficulus* (Rudow), Fahrenholz, *Archiv für Naturgeschichte,* Abt. A, 81: 11: 24–26; t. figs. 19, 20.
1924. *Linognathus forficulus* (Rudow), Freund, *Prager Tierärztlicher Archiv,* 40: 59; figs. 9, 10.
1927. *Linognathus stenopsis* (Burmeister), Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report,* 11–12: 737.

PREVIOUS RECORDS. Recorded originally from domestic goats and many times from this host in various parts of the world. Also recorded

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by Nitzsch as *Pediculus schistopygus* from *"Antilope rupicapra"*; and Rudow as *Haematopinus rupicaprae* from the same host, and as *Haematopinus forficulus* from *Capra ibex*.

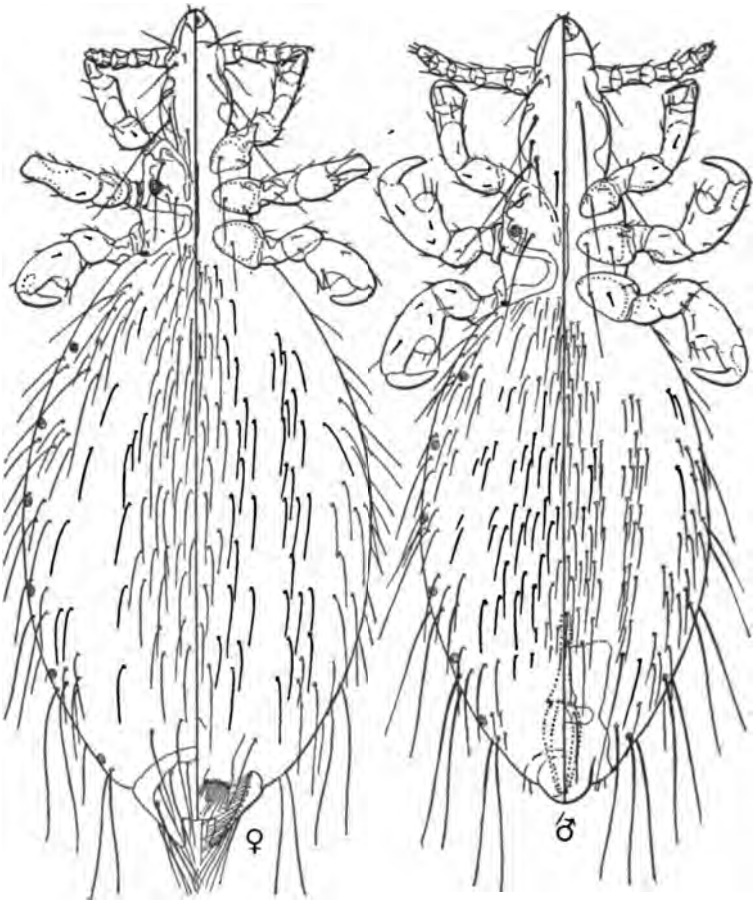

FIG. 211.—*Linognathus stenopsis* (Burmeister), male and female. From goat, San Diego, California, U.S.A.

SPECIMENS EXAMINED. Two males and a female in the Hamburg Museum collection, originally preserved in alcohol, but mounted on a slide by the present writer, bearing a label, *"Haematopinus forficulus* Rudow von *Capra ibex* A. Poppe determn. 1881/2," and *"Linog. forfic.* (Rudow) ausscheinend Rudows Typen H. Fahrenholz i. litt. 3, 1916."

Two females from the same collection, one badly damaged, preserved in alcohol, but mounted by the present writer, bearing the data, *"Haemat-*

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rupicaprae Rd. von *Caprella rupicapra* A. Poppe determ. 1881/2,"
id "*Linognathus schistopygus* (N.) H. Fahrenholz determ. in litt."

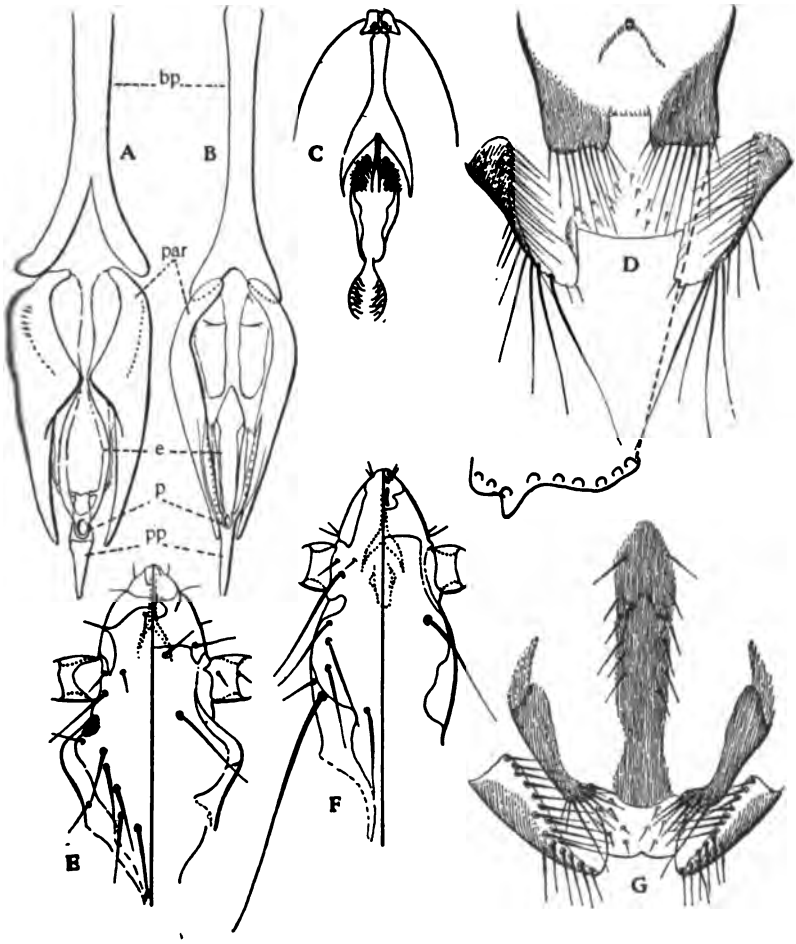

FIG. 212.—*Linognathus stenopsis* (Burmeister): *A*, genitalia of male; *C*, pharyngeal framework; *D*, genital region of female; *F*, head. *Linognathus africanus* Kellogg and Paine: *B*, genitalia of male; *E*, head; *G*, genital region of female.

Other specimens from domestic goat; Cambridge, England, *Nuttall* (Molteno Institute); San Diego, California, U.S.A. (Stanford University); Aberdeen, Cape Colony, Africa, *Hill* (Stanford University); Nagana Research Laboratory, Zululand, 28–30: VII: 22, *H. H. Curson* (British Museum); Punjaub District, India, *Capt. H. E. Cross* (British

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Museum); Mossgiel and Ivanhoe, New South Wales, Australia (Imperial Bureau of Entomology). From domestic sheep, Surnabad, Transcaucasia, 29: X: 1903, *Dr. E. Dschunkowsky* (Molteno Institute).

FEMALE (Fig. 211). Length attaining 3–3.5 mm. *Head* (Fig. 212*F*) elongate and slender, the fore head sharply parabolic, the antennae set quite well forward, the hind head with the lateral margins smoothly and but slightly convex; fore head with a transverse band on the ventral side extending partially to the dorsal side; hind head with lateral markings as indicated in the figure; dorsal setae unusually long and slender, the posterior lateral seta being nearly as long as the head; pharynx (Fig. 212*C*) with brushes; mouth parts only slightly exceeding the posterior margin of the head.

Thorax about as long as the head, quite narrow and parallel-sided; sternal plate present, very small and narrow.

Abdomen relatively very large, elongate oval, moderately hairy, the setae very slender and arranged in the normal pattern. *Spiracles* of the normal, globular form, not strikingly large. *Gonopophyses* (Fig. 212*D*) of a distinctive type, broadly truncate, with setae only along the apical margin which bears a distinct tooth; median genital plate lacking; apical lobes prominent, fringed with long setae.

MALE (Fig. 211). Length 2 mm. In general very similar to the female. *Genitalia* (Fig. 212*A*) with the parameres (*par*) large and stout, expanded mesally about their middle, the rather indistinct, but ring-shaped, endomeral piece (*e*) lying caudad of this expansion; apex of the abdomen ending in a simple, blunt point.

NOTES.—A very considerable amount of confusion, in which the present writer has participated, has existed in regard to the sucking lice of domestic goats. There are upon these animals two perfectly distinct species, both of which apparently may also occur upon sheep and both of which have passed under the name of *Linognathus stenopsis* as well as under other names.

The first name to be applied to a goat-infesting species was *Pediculus stenopsis* Burmeister (1838). As far as the original description is concerned the species is recognizable only—and that largely by inference—as a species of *Linognathus*, but it is this name which has become established in literature for the sucking lice of goats and it should if possible be preserved.

The second name which enters into this problem is *Haematopinus saccatus* Gervais (1844). This was based upon a single specimen, "sur un Bouc d'Egypte." Later authors have attempted to supply this "buck" with a scientific name and it has been referred to as *Capra aegyptica*. There is in fact no evidence that it was a goat at all, and the louse is recognizable merely as a species of *Linognathus*. The name is listed later in these pages and will not be further discussed here.

The third name is *Pediculus schistopygus* Nitzsch (1864), for a species from "*Antilope rupicapra*." Giebel was apparently partially responsible for the name and he himself later (1874) placed the species as a synonym of *stenopsis*. We may conse-

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quently accept his views as a first definite fixation of the species and if we can identify *schistopygus* we may reasonably start from this point.

In 1869 Rudow named two species, *Haematopinus forficulus* from *Capra ibex*, and *H. rupicaprae* from *Antilope rupicapra*. The specimens above recorded from the collections of the Hamburg Museum contain what are supposed to be the types of *H. forficulus* and other specimens that may be accepted as representing *H. rupicaprae*. The two are absolutely identical, and since we may reasonably assume that *H. rupicaprae* Rudow is the same as *Pediculus schistopygus* Nitzsch from the same host, and since this species occurs upon domestic goats and was accepted by Giebel as being the *stenopsis* of Burmeister, it would seem reasonable to consider our problem as solved.

We may thus, by a somewhat devious but nevertheless satisfactory procedure, arrive at a fixation of the identity of *Linognathus stenopsis* (Burmeister) which will permit the conservation of this long-used name, although it is apparently the less common of the two species which occur on domestic goats. The species is recognizable at a glance by the character of the gonopophyses of the female. The male is less clearly marked, but is still recognizable by the genitalia.

5. Linognathus africanus Kellogg and Paine

FIGS. 212 *B, E, G;* 213

1911. *Linognathus africanus* Kellogg and Paine, *Bulletin of Entomological Research,* 2: 146; pl. 4, figs. 1, 5.

1916. *Linognathus stenopsis* (Burmeister), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 165. (Part.)

1919. *Linognathus stenopsis* (Burmeister), Banks, *Philippine Journal of Science,* 14: 172. (Probably *africanus.*)

1927. *Linognathus stenopsis* (Burmeister), Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report,* 11–12: 737. (Part.)

PREVIOUS RECORDS. Definitely recorded only from the types, from sheep, Abeokuta, Southern Nigeria, Africa. On the basis of present knowledge it appears probable that some of the records of *L. stenopsis* from goats refer at least in part to this species.

SPECIMENS EXAMINED. The types (Stanford University and British Museum) and numerous other specimens as follows:

From sheep: Sugar City, Colorado, and Miami, Florida, U.S.A. (Stanford University); Punjab District, India, *Capt. H. E. Cross* (Briitsh Museum); and a single slide in the Piaget Collection (British Museum) labeled "*Haematopinus tibialis* var. *appendiculatus* sur un mouton hybride."

From goat: Miami, Florida, U.S.A. (Stanford University); Los Baños, Philippine Islands, *Woodworth* (Stanford University); Lahore, Punjab (Indian Museum) and Punjab District, *Capt. H. E. Cross* (British Museum); Lake Suai, Abyssinia, 26: 11: 1912, *Jannasch Goetz,* and Nagana Research Laboratory, Zululand, *H. H. Curson* (British Museum); Anderstepoort, Transvaal, *Bedford.*

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From "Klip springer," *Oreotragus saltator,* Somaliland, *R. E. Drake-Brockman* (British Museum).

FEMALE (Fig. 213). Length 2–2.5 mm. In general very similar to *L. stenopsis* but differing sharply in certain details. *Head* (Fig. 212*E*) with the lateral margins of the hind head strongly and angularly convex; dorsal setae in no case very long and slender. *Abdomen* with the setae apparently somewhat stouter than in *stenopsis*. *Gonopophyses* (Fig. 212*G*) slender, convergent, narrowly rounded at the apex, which bears a cluster of slender setae; median plate present, large and elongate; apical lobes apparently somewhat shorter than in *stenopsis*.

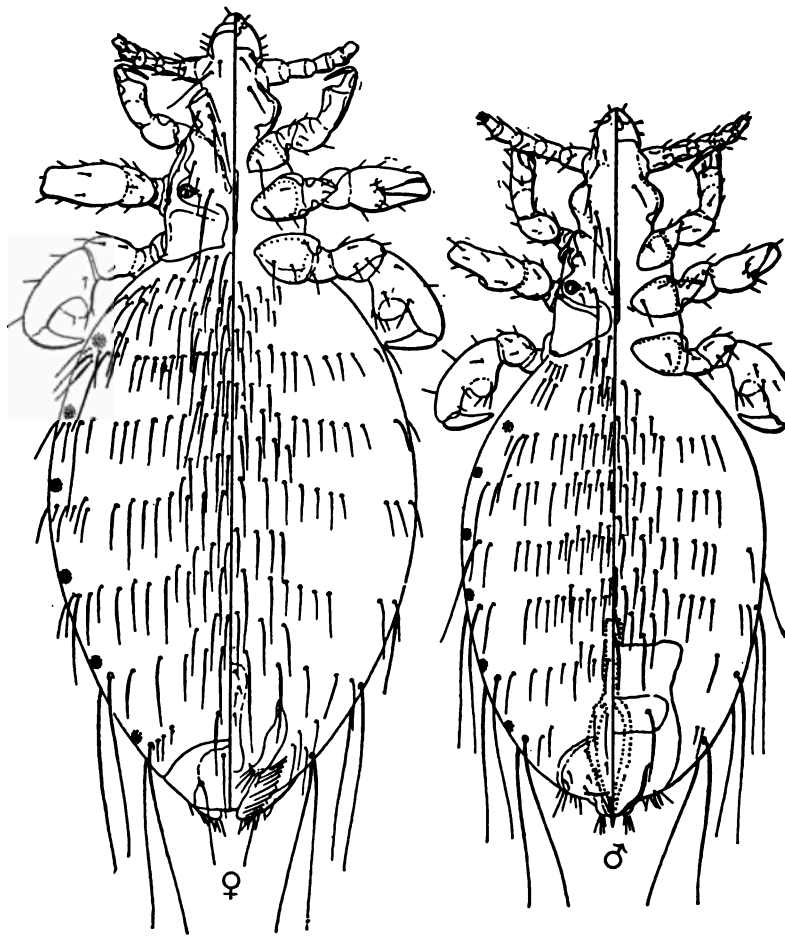

FIG. 213.—*Linognathus africanus* Kellogg and Paine, male and female. From the types.

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MALE (Fig. 213). Length 1.5–1.75 mm. In general very similar to the female but slightly less hairy. *Genitalia* (Fig. 212 *B*) differing from those of *stenopsis* in having the parameres (*par*) without a mesal expansion and in having the endomeral piece (*e*) in the form of a very narrow, almost tube-like structure inclosed between the apical half of the parameres.

NOTES.—The females of *L. africanus* and *L. stenopsis* are separable at a glance by the character of the gonopophyses. The males are somewhat more difficult to distinguish as the head form is subject to some distortion and the genitalic parts are crowded and more or less obscure, but with favorable specimens there need be no confusion.

The specimens from *Oreotragus* agree in every respect with typical *L. africanus*.

6. Linognathus oviformis (Rudow)

1869. *Haematopinus oviformis* Rudow, *Zeitschrift für die gesamten Naturwissenschaften*, 34: 170.
1874. *Haematopinus oviformis* Rudow, Giebel, *Insecta Epizoa*, p. 47.
1880. *Haematopinus oviformis* Rudow, Piaget, *Les Pediculines*, p. 648.
1908. *Haematopinus (?) oviformis* Rudow, Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 11.
1916. *Haematopinus (?) oviformis* Rudow, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 144.
1916. *Linognathus oviformis* (Rudow), Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, 81: (Heft) 11: 33.

PREVIOUS RECORDS. Known only from the original record by Rudow, from *"Hircus manifricius."*

NOTES.—The original description indicates merely that this is a species which is "dem *H. vituli* am ähnlichsten in der Form des Kopfes und des Abdomens." It is in all probability either *Linognathus stenopsis* or *L. africanus*, but unless the types should be discovered still to be in existence there is no point to carrying it further in our literature. It should simply be placed as unrecognizable and disregarded.

7. Linognathus saccatus (Gervais)

1845. *Haematopinus saccatus* Gervais, in Walckenaer, *Histoire Naturelle des Insectes Aptères*, 3: 307.
1904. *Trichaulus saccatus* (Gervais), Enderlein, *Zoologischer Anzeiger*, 28: 142.
1905. *Linognathus saccatus* (Gervais), Enderlein, *ibid.*, 29: 194.
1908. *Linognathus saccatus* (Gervais), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 12.
1916. *Linognathus stenopsis* (Burmeister), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 164. (Part.)

PREVIOUS RECORDS. Known only from the original description from "un Bouc d'Egypte," in a zoölogical garden.

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NOTES.—The original description of this species, which was based upon a single specimen, indicates only that the species belongs to *Linognathus*. For some reason later authors have translated "un Bouc d'Egypte" into *"Capra aegyptiaca."* There is in fact no necessity for concluding that the species came even from a goat.

Unless, by some miracle, the type still exists, the reasonable procedure is to place the species definitely as unrecognizable and to cease troubling about it.

8. Linognathus vituli (Linnaeus)

FIGS. 214, 215, 216 *C*

NOTE.—This being a very well known parasite of domestic cattle, there are many references which have no significance from the point of view of the present work. Consequently only those are included which aid in elucidating the nomenclatorial history of the species or which contribute something to the knowledge of its distribution or morphology.

1758. *Pediculus vituli* Linnaeus, *Systema Naturae,* (ed. 10), p. 611.
1761. *Pediculus vituli* Linnaeus, Linnaeus, *Fauna Suecica,* p. 475.
1764. *Pediculus bovis vituli* Linnaeus, Geoffroy, *Histoire Abrégée des Insectes,* 2: 598.
1781. *Pediculus vituli* Linnaeus, Fabricius, *Species Insectorum,* 2: 476.
1800. *Pediculus vituli* Linnaeus, Latreille, *Histoire naturelle générale et particulière des crustacés et des insectes,* p. 93.
1805. *Pediculus vituli* Linnaeus, Fabricius, *Systema Antliatorum,* p. 342.
1829. *Haematopinus vituli* (Linnaeus), Stephens, *Catalogue of British Insects,* 2: 329.
1838. *Pediculus tenuirostris* Burmeister, *Genera Insectorum, Rhynchota,* Species 17.
1842. *Haematopinus vituli* (Linnaeus), Denny, *Monographia Anoplurorum Britanniae,* p. 31; pl. 25, fig. 3.
1844. *Haematopinus vituli* (Linnaeus), Gervais, in Walckenaer, *Histoire naturelle des insectes aptères,* 3: 307.
1864. *Pediculus oxyrrhynchus* Nitzsch, *Zeitschrift für die gesamten Naturwissenschaften,* 23: 21.
1874. *Haematopinus tenuirostris* (Burmeister), Giebel, *Insecta Epizoa,* p. 43; pl. 2, fig. 9.
1880. *Haematopinus tenuirostris* (Burmeister), Piaget, *Les Pediculines,* p. 650.
1883. *Haematopinus tenuirostris* (Burmeister), Stroebelt, *Annals and Magazine of Natural History,* (5), 11: 73–108; pl. 3.
1885. *Haematopinus tenuirostris* (Burmeister), Piaget, *Les Pediculines,* Supplement, p. 145; pl. 15, fig. 8.
1891. *Haematopinus vituli* (Linnaeus), Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (old series), 7: 16; fig. 7.
1896. *Haematopinus vituli* (Linnaeus), Osborn, *ibid., Bulletin* (new series), 5: 176; fig. 101.
1904. *Trichaulus vituli* (Linnaeus), Enderlein, *Zoologischer Anzeiger,* 28: 142.
1905. *Linognathus vituli* (Linnaeus), Enderlein, *ibid.,* 29: 194.
1908. *Linognathus vituli* (Linnaeus), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 12.
1913. *Linognathus vituli* (Linnaeus), Patton and Cragg, *Textbook of Medical Entomology,* p. 513; pl. 66, fig. 3.

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16. *Linognathus vituli* (Linnaeus), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 166. (Part.)
23. *Linognathus vituli* (Linnaeus), Dudich, *Rovartani Lapok,* 26: 59.
24. *Linognathus vituli* (Linnaeus), Freund, *Prager Tierärztliche Archiv, 4A:* 57; fig. 8.
27. *Linognathus vituli* (Linnaeus), Freund, *Prager Archiv für Tiermedisin, 7A:* 46; fig. 7.

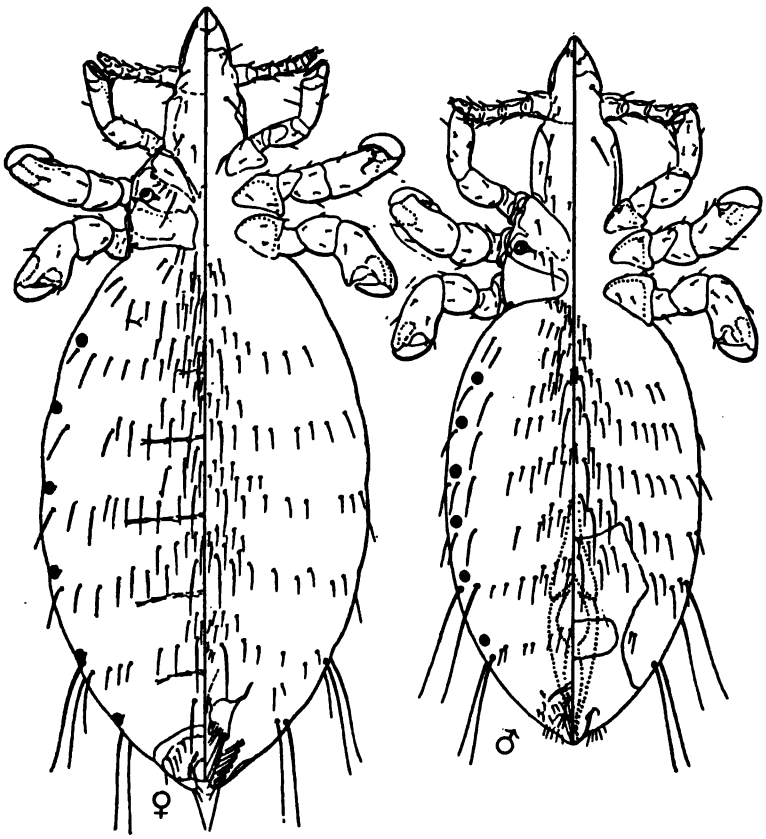

FIG. 214.—*Linognathus vituli* (Linnaeus), male and female.

PREVIOUS RECORDS. From domestic cattle in Europe, North America, nd India. Recorded by Dudich (1923) from wild boar in Hungary.

SPECIMENS EXAMINED. From domestic cattle, Lafayette, Indiana, *ishopp,* and Mountain View, California, U.S.A. (Stanford University); pper Shire District, Nyasaland, 12: 10: 09, *Carden* (Molteno Institute) id North Nyasa, Africa, *J. B. Davey* (British Museum); Rangoon,

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Burma, VI: 1912, *H. H. Marshall* (Molteno Institute); Sydney, New South Wales, Australia (Imperial Bureau of Entomology).

Labeled merely "off sheep AA. 93" (British Museum).

From dog, Cambridge, England, *Professor Newton,* XI: 1897 (Molteno Institute).

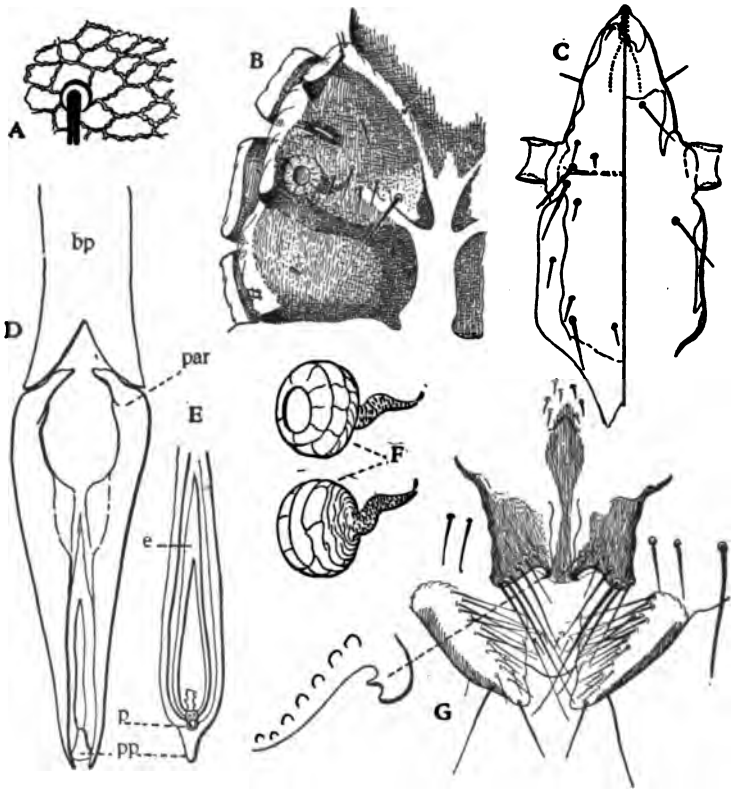

FIG. 215.—*Linognathus vituli* (Linnaeus): *A*, ornamentation of derm of abdomen; *B*, dorsum of thorax; *C*, head; *D*, genitalia of male; *E*, endomeral pieces of male genitalia; *F*, spiracle; *G*, genital region of female with detail of gonopod.

FEMALE (Fig. 214). Length 2.5 mm. *Head* (Fig. 215 *C*) elongate, the fore head acutely conical, slightly shorter than the hind head, which has the lateral margins straight and parallel; entire head quite strongly sclerotic and pigmented, with a darker longitudinal band along the lateral margins of the hind head; dorsal setae small; pharynx (Fig. 216 *C*) without brushes, mouth parts reaching nearly to the posterior border of the thorax.

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Thorax (Fig. 215 *B*) with the dorsum strongly sclerotic; sternal plate entirely lacking.

Abdomen with the derm tending to be slightly sclerotic, the pattern of reticulations (Fig. 215 *A*) strongly defined; setae small and rather few, arranged in the characteristic pattern; *spiracles* (Fig. 215 *F*) moderately large. *Gonopophyses* (Fig. 215 *G*) of a very distinctive form, set close together, broad, with the posterior margin emarginate and bearing a sclerotic hook at the inner angle; median genital plate slender; apical lobes short.

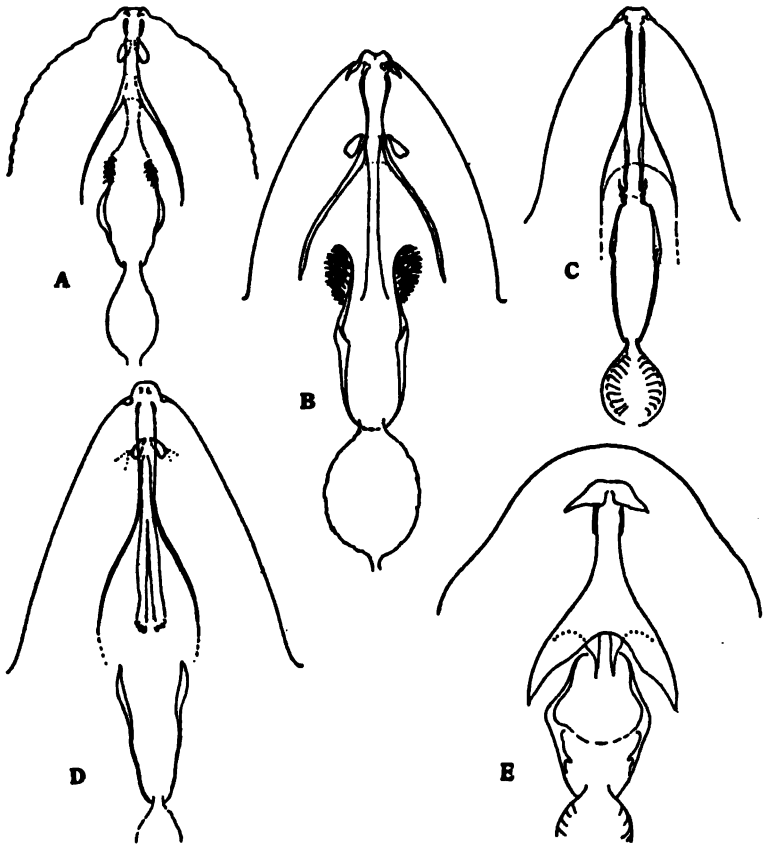

FIG. 216.—Pharyngeal framework of: *A, Linognathus breviceps* (Piaget); *B, L. tibialis* (Piaget); *C, L. vituli* (Linnaeus); *D, L. brevicornis* (Giebel); *E, L. setosus* (Olfers).

MALE (Fig. 214). In general very similar to the female. *Genitalia* (Fig. 215 *D, E*) with the basal plate (*bp*) scarcely longer than the terminal complex; parameres (*par*) long and acutely tapering, almost en-

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tirely concealing the delicate, elongate, ring-like endomeral piece (*e*) a the slender arms of the small pseudopenis (*pp*); apex of the abdom terminating in a simple point.

NOTES.—The distinctively formed head and the genitalic characters of both ma and female distinguish this species readily from any other. It has no known cl relatives.

The identification of this with the *Pediculus vituli* of Linnaeus is entirely tr ditional, but there is no occasion to disturb the customarily accepted nomenclature a this late date. The peculiar records from sheep, dog, and wild boar should be treate with doubt until confirmed by further and more definitely authenticated collections.

9. Linognathus tibialis (Piaget)

FIGS. 216 *B*, 217, 218

1880. *Haematopinus tibialis* Piaget, *Les Pediculines*, p. 646, pl. 52, fig. 8.
1880. *Haematopinus tibialis* var. *antennatus*, Piaget, *ibid.*, p. 647.
1880. *Haematopinus tibialis* var. *appendiculatus*, Piaget, *ibid.*, p. 647.
1904. *Trichaulus tibialis* (Piaget), Enderlein, *Zoologischer Anzeiger*, **28**: 142.
1905. *Linognathus tibialis* (Piaget), Enderlein, *ibid.*, **29**: 194.
1908. *Linognathus tibialis* (Piaget), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 12.
1908. *Linognathus tibialis* var. *antennatus* (Piaget), Dalla Torre, *ibid.*, p. 12.
1908. *Linognathus tibialis* var. *appendiculatus* (Piaget), Dalla Torre, *ibid.*, p. 12.
1914. *Linognathus tibialis* var. *euchore* Waterston, *Annals of the South African Museum*, **10**: 275; fig.
1916. *Linognathus tibialis* (Piaget), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), **6**: 165.
1916. *Linognathus tibialis* var. *antennatus* (Piaget), Ferris, *ibid.*, p. 165.
1916. *Linognathus tibialis* var. *appendiculatus* (Piaget), Ferris, *ibid.*, p. 166.
1916. *Linognathus tibialis* var. *euchore* Waterston, Ferris, *ibid.*, p. 166.
1920. *Linognathus tibialis* (Piaget), Bedford, *Director of Veterinary Research, Union of South Africa, Report*, 7–8: 709.
1920. *Linognathus tibialis* var. *euchore* Waterston, Bedford, *ibid.*, p. 709.
1927. *Linognathus tibialis* var. *euchore* Waterston, Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report*, 11–12: 738.

PREVIOUS RECORDS. Recorded by Piaget from *"Antilope maori," "Antilope subgutturosa,"* and *"Antilope* sp.," Zoölogical Garden, Rotterdam, the types being from the first named. Recorded by Waterston as *Linognathus tibialis* var. *euchore* from *Antilope euchore*, South Africa, and by Bedford from *Aepyceros melampus*, South Africa.

SPECIMENS EXAMINED. Eight slides, containing eighteen individuals, males, females, and immature, from the Piaget Collection (British Museum) labeled *"Haematopinus tibialis* P. sur une *Antilope maori."*

Four slides, containing fifteen individuals, males, females, and immature, from the same collection, labeled *"Haematopinus tibialis* var. *appendiculatus* sur une *Antilope subgutturosa."*

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Four slides containing eight individuals, male and female, from the same collection, labeled *"Haematopinus tibialis* var. *antennatus, Antilope caama."* These slides are undoubtedly the types of all the supposed varieties of *L. tibialis* described by Piaget.

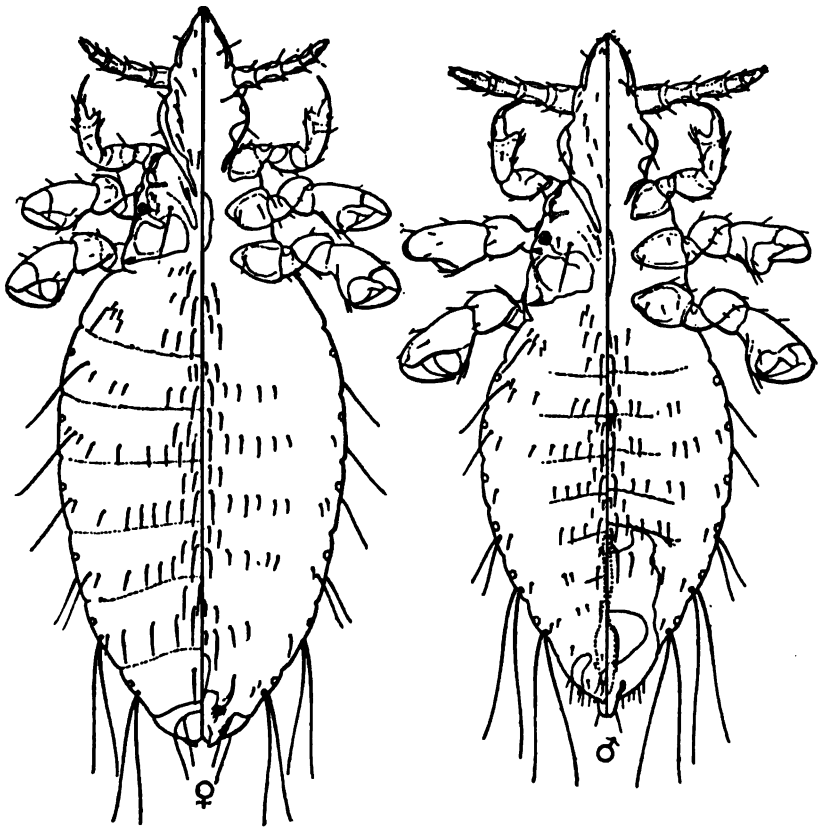

FIG. 217.—*Linognathus tibialis* (Piaget), male and female. From the types.

In addition, one slide from the Piaget Collection, labeled *"Haematopinus tibialis* v. *appendiculatus* sur un mouton hybride," which is not referred to in *Les Pediculines,* contains specimens belonging to *Linognathus africanus* Kellogg and Paine.

All these slides were remounted by the writer but, aside from the clearing and staining of the specimens, will be found in exactly the condition as to numbers and distribution on the slides in which they were left by Piaget.

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In addition to these, the types of *Linognathus tibialis* var. *euchore* Waterston were examined through the kindness of the authorities of the South African Museum, who loaned them.

Two females from "*Gazella subgutturosa* (Gould), aus d. Kaukasus importiert, Zoolog. Garten Hamburg, 3, VI . 1914 Zool. Gesellschaft ded. 6 . VI . 1914," in the collection of the Hamburg Museum are unquestionably this species.

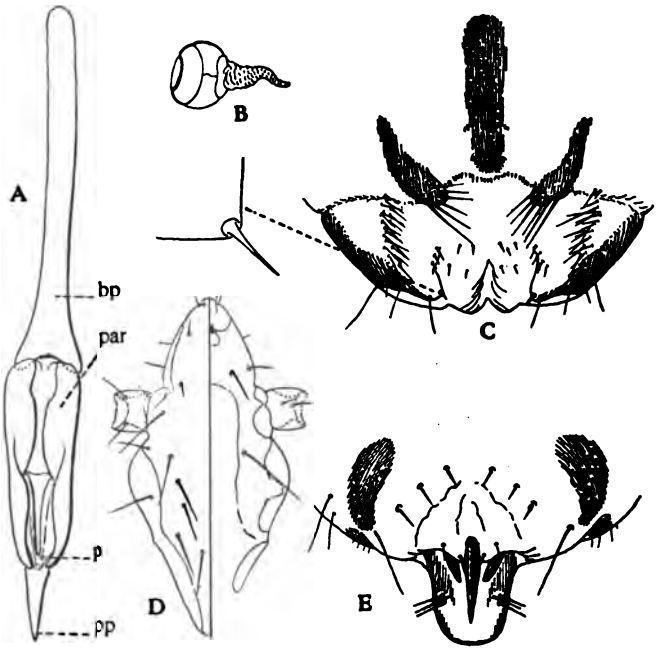

FIG. 218.—*Linognathus tibialis* (Piaget): *A*, genitalia of male; *B*, spiracle; *C*, genital region of female, with detail; *D*, head; *E*, apex of abdomen of male.

Other specimens from *Antidorcas marsupialis*, Onderstepoort, Pretoria, South Africa, received through the kindness of Mr. G. A. H. Bedford seem to be the same.

FEMALE (Fig. 217). Length 2–2.5 mm. A comparatively delicate species. *Head* (Fig. 218 *D*) quite heavily sclerotic and pigmented, rather slender, the fore head acutely pointed and about equal in length to the free portion of the hind head; fore head with the usual transverse band on the ventral side, this extending slightly to the dorsum, hind head with strongly sclerotic lateral bands and with the margins convex and more or less angulate; pharynx (Fig. 216 *B*) with strongly developed brushes; mouth parts very long, reaching to the posterior border of the thorax.

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Thorax about as long as the head, with the lateral margins diverging slightly posteriorly; sternal plate small, narrow.

Abdomen slender oval, membranous throughout with no indication of pigmentation, sparsely haired, the setae arranged in the normal pattern but noticeably small and slender. *Spiracles* (Fig. 218 *B*) small, globular, with few and relatively large reticulations. *Gonopophyses* (Fig. 218 *C*) very small, slender, convergent, rounded at the apex and with an apical cluster of small setae; median genital plate present, in some specimens slightly expanded anteriorly, in others nearly parallel-sided; apical lobes small and inconspicuous, fringed with small setae, terminating in a small setiform spine.

MALE (Fig. 217). Length 1.5 mm. In general characters closely resembling the female, but with the abdomen more pointed and even more sparsely haired, with the hairs smaller. *Genitalia* (Fig. 218 *A*) with the parameres (*par*) almost straight and set close together, concealing the other structures; the endomeral piece is apparently entirely lacking, there remaining only the tubular penis (*p*) and the pseudopenis (*pp*). It is not possible from the material at hand to get the exact details, but the absence of the endomeral piece is clear. Apex of the abdomen terminating (Fig. 218 *E*) in a sclerotic process, which is a prolongation of the ninth sternite.

NOTES.—The examination of the Piaget material reveals absolutely no basis for the supposed varieties named by him. The differences which he indicated were evidently illusory and due in all probability to the nature of his preparations. On the other hand, the specimens from "mouton hybride," which were evidently not a part of his original material, have nothing to do with *L. tibialis* and are here referred to *L. africanus*. It is especially fortunate that the opportunity has arisen to clear up this species, for much doubt has existed concerning it and the nomenclature of the antelope-infesting species of *Linognathus* has been very much confused because of the fact that no one has known what *L. tibialis* and its so-called varieties actually represent.

Linognathus cervicaprae (Lucas), which has at times been placed as a "variety" of *L. tibialis*, is here treated as an unrecognizable species and will be discussed later.

Linognathus tibialis var. *euchore* Waterston is also, in the writer's opinion, based upon examination of the types, purely a synonym of *L. tibialis*.

Linognathus tibialis var. from *"eland"* in the Zoölogical Gardens of Edinburgh, recorded by Cummings,[1] has nothing to do with *L. tibialis*. The material is in bad shape and it is difficult to say exactly what it is, however.

While there are several species of the general type of *L. tibialis*, there are none which approach it so closely as to cause difficulty except *L. brevicornis* (Giebel), which is very similar to *L. tibialis* but apparently distinct.

L. brevicornis may be separated in the female by the fact that the gonopophyses are divergent, rather than convergent, and in the male by the presence of the endomeral piece in the genitalia.

[1] Cummings, B. F., *Proceedings of the Zoölogical Society of London*, 1916, p. 266, fig. 6.

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10. Linognathus cervicaprae (Lucas)

1847. *Haematopinus cervicaprae* Lucas, *Annales de la Société Entomologique de France*, (2), 5: 534; pl. 8, fig. II, 1–1*h*.
1880. *Haematopinus tibialis* var. *cervicaprae* Lucas, Piaget, *Les Pediculines*, p. 647.
1908. *Linognathus tibialis* var. *cervicaprae* (Lucas), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 13.
1916. *Linognathus tibialis* var. *cervicaprae* (Lucas), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 166.

PREVIOUS RECORDS. Known only from the original record by Lucas, from *Antilope cervicapra* in a menagerie in Paris.

NOTES.—The original description and figures show this species to be a *Linognathus* of the general appearance of *L. tibialis* (Piaget). Beyond this nothing can be determined. It has nothing to do with *L. pithodes* Cummings, which was described from the same host species. It is entirely possible that the species is not normal to this host, but should a species of this type be found on *Antilope cervicapra* under such conditions as to preclude the chance of straggling from some other host it could be accepted as *L. cervicaprae*.

It is obvious that under the rules of nomenclature now commonly accepted, *L. cervicaprae* could in no case be placed as a "variety" of *L. tibialis*, it having priority over the latter. Should the two prove to be identical, it is the name *cervicaprae* which must be preserved.

11. Linognathus brevicornis (Giebel)

FIGS. 216 *D*, 219

1874. *Haematopinus brevicornis* Giebel, *Insecta Epizoa*, p. 43.
1880. *Haematopinus brevicornis* Giebel, Piaget, *Les Pediculines*, p. 644; pl. 52, fig. 7.
1904. *Trichaulus brevicornis* (Giebel), Enderlein, *Zoologischer Anzeiger*, 28: 142.
1905. *Linognathus brevicornis* (Giebel), Enderlein, *ibid.*, 29: 194.
1908. *Linognathus brevicornis* (Giebel), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 12.
1916. *Linognathus brevicornis* (Giebel), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 161.

PREVIOUS RECORDS. From *Giraffa camelopardalis* in a zoölogical garden.

SPECIMENS EXAMINED. Two females from the Piaget Collection, mounted upon a single slide and labeled "*Haematop. brevicornis* sur une *Camelopardalis giraffa*." These were remounted by the present writer.

FEMALE (Fig. 219). Length 2.2–2.25 mm. *Head* (Fig. 219 *B*) elongate, the antennae set at about the middle, the fore head acutely pointed, the hind head with the lateral margins but slightly convex; lateral margins of the hind head with a conspicuous, sclerotic, longitudinal band which is continuous with the occipital prolongation into the thorax; fore

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head with a conspicuous, transverse, ventral, sclerotic band; setae few and small. Pharynx without brushes.

Thorax about as long as the head and rather broad; sternal plate lacking.

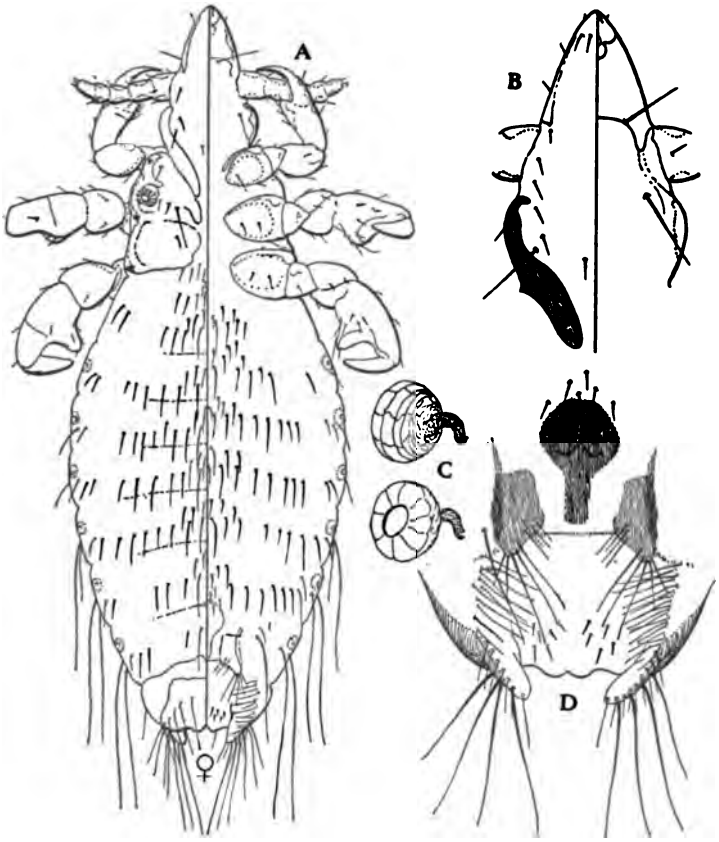

FIG. 219.—*Linognathus brevicornis* (Giebel): *A*, female; *B*, head; *C*, spiracle; *D*, genital region. From specimen in the Piaget Collection.

Abdomen with the normal pattern of setae; margins with long setae only on the sixth to eighth segments; *spiracles* (Fig. 219 *C*) moderately large, the outer face somewhat rosettiform. *Gonopophyses* (Fig. 219 *D*) very small, their apices divergent, the free mesal margins with a few small setae; median genital plate small, quite strongly spatulate; apical lobes moderately prominent, bearing numerous small setae on the mesal margin and three or four very long setae on the outer margin.

NOTES.—This species has been taken only from giraffe in captivity and it remains to be shown that it is normal to this host. It is very closely related to the next species,

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the two being separable only by slight details which will be pointed out in connection with the latter.

12. **Linognathus fractus** n. sp.

FIGS. 220, 221

SPECIMENS EXAMINED. Holotype, a female, allotype and one paratype female from *Tragelaphus sylvaticus,* Onderstepoort, Pretoria, South Africa, July 1930, *G. A. H. Bedford.* Holotype and allotype in the collection of Mr. Bedford, paratype in collection of Stanford University.

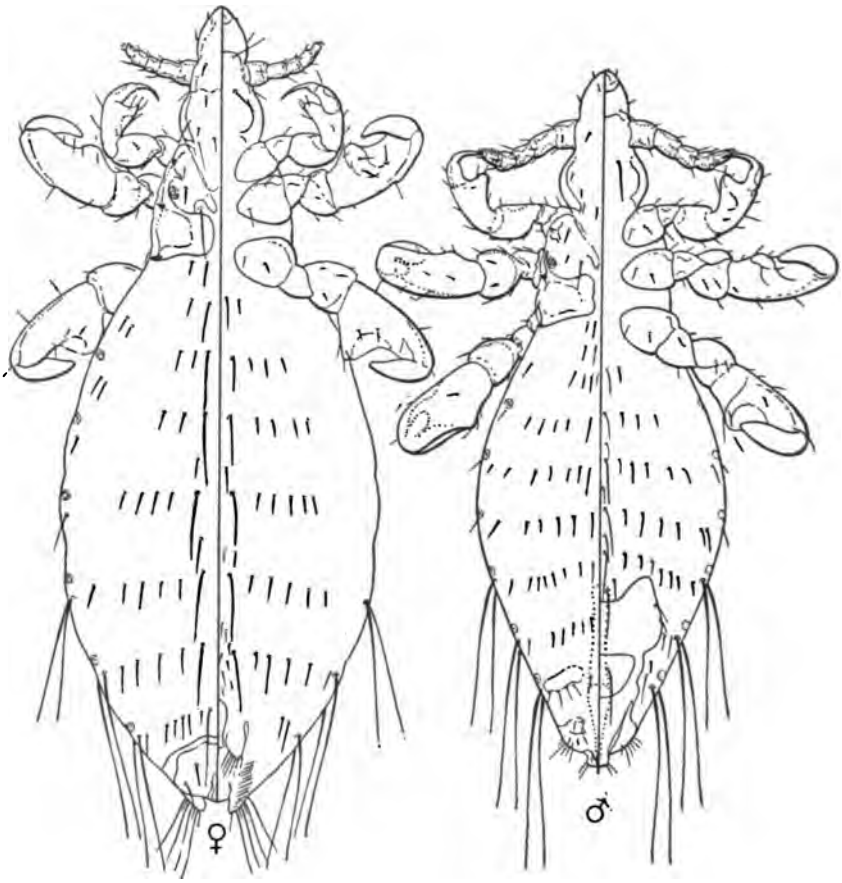

FIG. 220.—*Linognathus fractus* n. sp., male and female.

FEMALE (Fig. 220). Length 2.25 mm. *Head* (Fig. 221 *C*) elongate, the antennae set slightly forward of the middle; fore head rather sharply parabolic, hind head with the margins smoothly convex, the whole strongly

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sclerotic dorsally except for a transverse band between the bases of the antennae; hind head with a conspicuous, sclerotic band along each lateral margin, this band being broken at the beginning of the occiput; ventral side of the hind head with an irregularly shaped lateral, sclerotic area and the ventral side of the fore head with a strong transverse band. Pharynx without brushes.

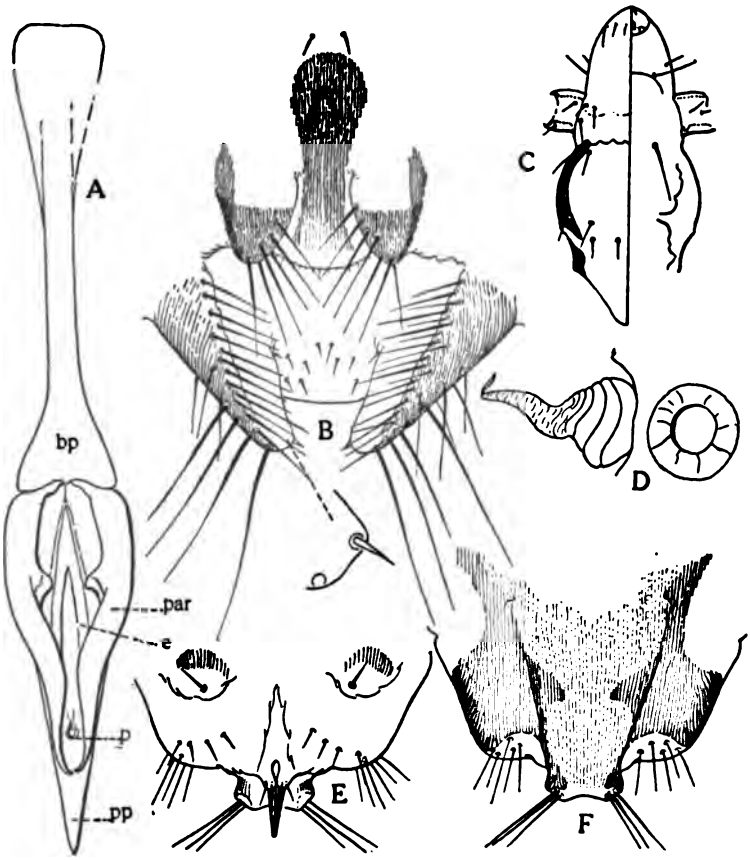

FIG. 221.—*Linognathus fractus* n. sp.: *A*, genitalia of male; *B*, genital region of female; *C*, head; *D*, spiracle; *E*, dorsal aspect of apex of abdomen of male; *F*, ventral aspect of same.

Thorax about as long as the head; sternal plate lacking.

Abdomen with the setae greatly reduced in number, the anterior group or row on each segment either lacking or reduced to two or three small setae; long setae present at lateral margins of sixth to eighth segments. *Gonopophyses* (Fig. 221 *B*) relatively small, their mesal margins divergent

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and bearing a few setae, the margin of the vulva strongly convex, the median genital plate relatively small and slightly spatulate; apical lobes moderately prominent, bearing a mesal fringe of small setae and three or four long setae on the outer margin.

MALE (Fig. 220). Length 2 mm. *Head* and *thorax* as in the female. *Abdomen* quite acute posteriorly, with the dorsal and ventral setae even smaller than in the female. Eighth and ninth tergites each with a pair of small sclerotic areas (Fig. 221 *E*). Apex of the abdomen (Fig. 221 *E, F*) terminating in a slightly expanded, truncate median lobe formed by the prolongation of the ninth sternite. *Genitalia* (Fig. 221 *A*) with the basal plate (*bp*) long and slender, the parameres (*par*) slender and acutely tapering and with a conspicuous point about midway of the mesal margin; endomeral parts (*e*) concealed in the single specimen at hand between the parameres, but apparently forming an elongate ring-shaped piece with the penis (*p*) at its apex; pseudopenis (*pp*) large and stout, projecting beyond the ends of the parameres.

NOTES.—This species is evidently very close to *L. brevicornis* (Giebel), of which unfortunately only the female is known. Certain apparent differences between the females are scarcely greater than might well come within the limits of normal variation, but others are probably significant. The one really clear difference is to be found in the form of the sclerotic, longitudinal band at the margin of the hind head. In *L. brevicornis* (Fig. 220 *B*) this is continued to the apex of the occiput, while in *L. fractus* (Fig. 221 *C*) it is broken at the beginning of the occiput and is of different form. In the absence of the male of *brevicornis* it appears desirable to regard the two species as distinct.

L. fractus is evidently a member of the *tibialis* group, from the other members of which the female can be distinguished by the form of the genital structures and the male by the form of the genitalia and the terminal structures of the abdomen.

13. Linognathus gnu Bedford

FIGS. 222, 223

1927. *Linognathus gnu* Bedford, *Transactions of the Royal Society of South Africa,* 14: 349; t. figs. 3, 4.
1927. *Linognathus ferrisi* Bedford, *ibid.,* 14: 351; t. figs. 5, 6. (Preoccupied.)
1929. *Linognathus gorgonus* Bedford, *Director of Veterinary Services, Union of South Africa, Report,* 15: 502.

PREVIOUS RECORDS. Type from *Connochaetes gnu,* Clocolan, Orange Free State; also from *Gorgon taurinus,* Zoutpansberg District, Northern Transvaal.

SPECIMENS EXAMINED. A male and a female from *Gorgon taurinus,* Maastrom, Northern Transvaal, received through the kindness of Mr. G. A. H. Bedford.

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FEMALE (Fig. 222). Length 2 mm. *Head* (Fig. 223 *D*) with the antennae set slightly forward of the middle, the fore head rather sharply parabolic, the hind head with the margins strongly and smoothly convex and strongly sclerotic; dorsal setae moderately convex; pharynx with brushes; mouth parts attaining only to the posterior margin of the head.

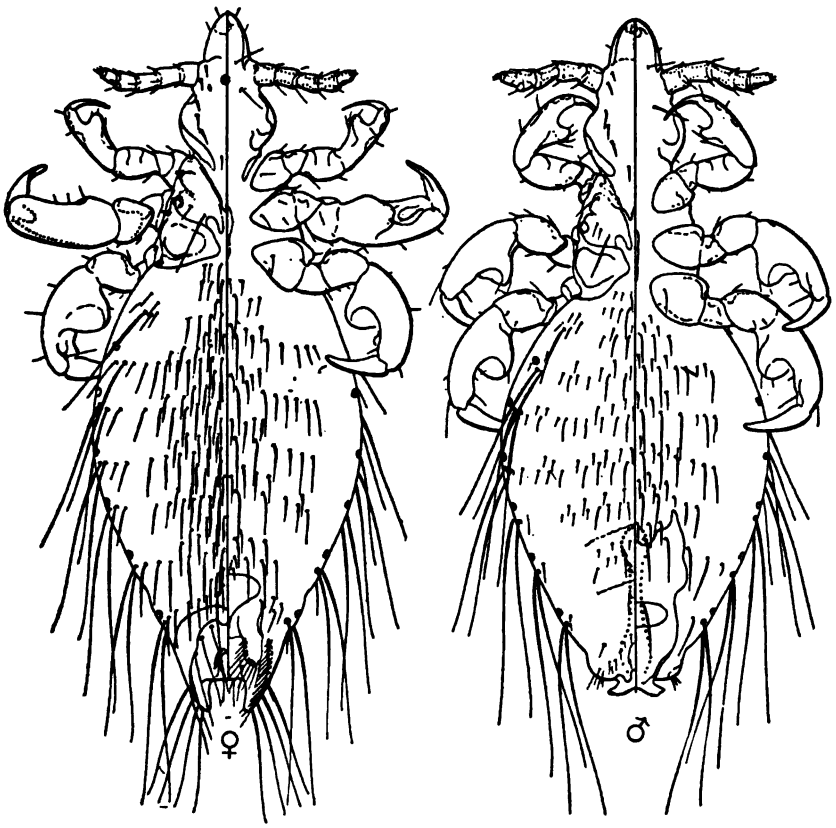

FIG. 222.—*Linognathus gnu* Bedford, male and female.

Thorax about as long as the head, its dorsum strongly sclerotic; sternal plate present, small and slender; *legs* noticeably large and stout.

Abdomen somewhat turbinate; setae arranged in the normal pattern, rather large, the lateral margins of segments two and three with one, and of four to eight with two very long setae. *Spiracles* (Fig. 223 *C*) quite small, with few reticulations. *Gonopophyses* (Fig. 223 *A*) large, elongate, somewhat spatulate, the apex with a series of moderately long setae; median genital plate short, broad, and triangular; apical lobes very promi-

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nent, with a fringe of small setae on the mesal margin and three or four very long setae on the outer margin.

MALE (Fig. 222). Length 1.5 mm. Very similar to the female but with the abdominal setae much smaller. *Genitalia* distorted in the single available specimen and apparently also in that upon which the original description was based; apex of the abdomen of very distinctive form, the median prolongation of the last sternite being flattened and expanded laterally (Fig. 223 *B*).

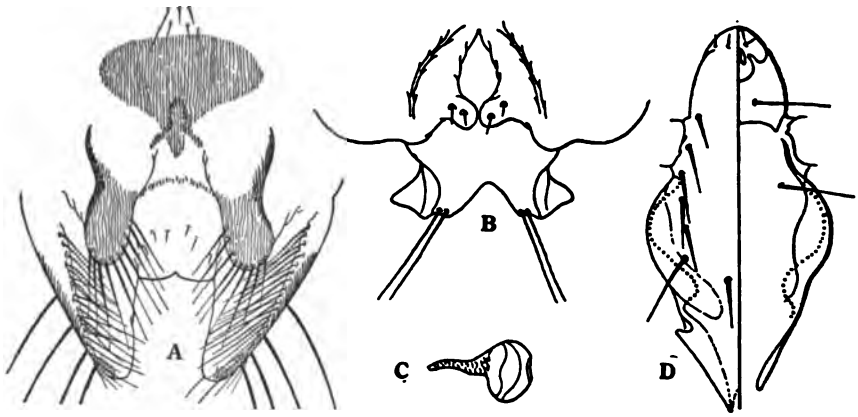

FIG. 223.—*Linognathus gnu* Bedford: *A*, genital region of female; *B*, apex of abdomen of male; *C*, spiracle; *D*, head.

NOTES.—The synonymy indicated above has been pointed out to the writer by Mr. Bedford, it having been occasioned by the fact that the male and female were originally taken from different hosts. The species is one of the general type of *L. tibialis* but is very well marked, the spatulate gonopophyses and triangular median genital plate of the female and the expanded apical process of the male distinguishing it at once from any other.

14. Linognathus fahrenholzi Paine

FIGS. 224, 225

1911. *Linognathus forficula* Kellogg and Paine, *Bulletin of Entomological Research*, 2: 47; pl. 4, figs. 2, 4. (Not *Haematopinus forficulus* Rudow.)
1914. *Linognathus fahrenholzi* Paine, *Psyche*, 21: 117.
1916. *Linognathus fahrenholzi* Paine, Ferris, *Annals of the Durban Museum*, 1: 239.
1916. *Linognathus fahrenholzi* Paine, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 161.
1927. *Linognathus fahrenholzi* Paine, Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report*, 11–12: 737.

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PREVIOUS RECORDS. Originally described from *Cervicapra arundinarum,* George's, Marimba District, Nyasaland. Recorded by Ferris from *Cervicapra fulvorufula,* Mfongosi, Zululand.

SPECIMENS EXAMINED. Those upon which the foregoing records were based.

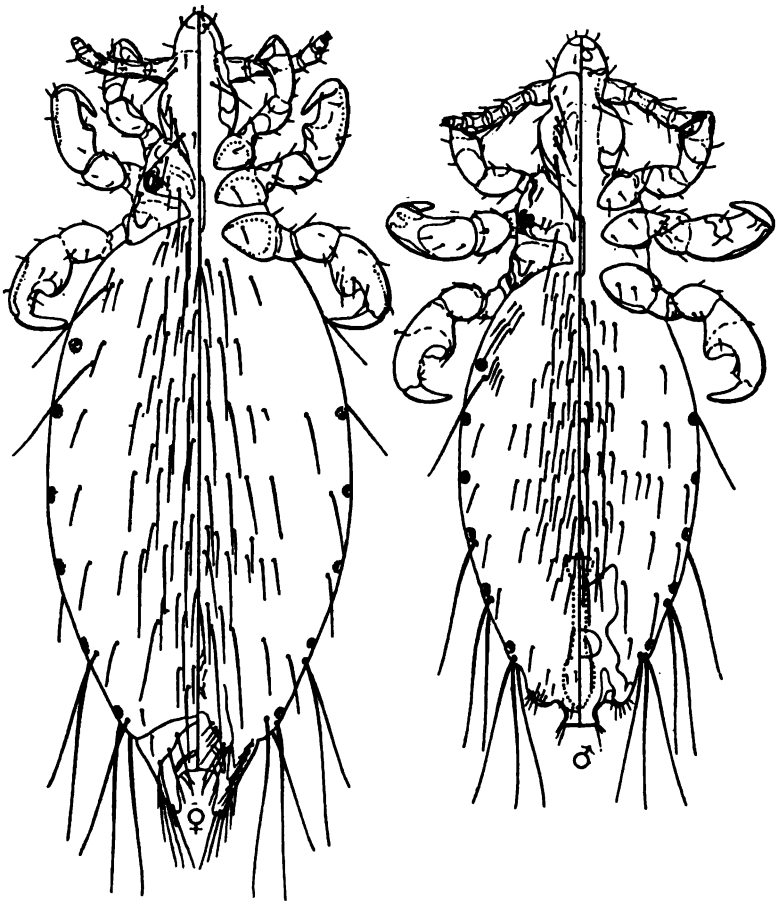

FIG. 224.—*Linognathus fahrenholzi* Paine, male and female. From paratypes.

FEMALE (Fig. 224). Length 2.5 mm. *Head* (Fig. 225 *F*) elongate, with the antennae set somewhat forward of the center, the fore head quite sharply parabolic, the hind head with the margins strongly and smoothly convex and with strong sclerotic areas; dorsal setae long and slender; pharynx with well-developed brushes; mouth parts attaining the posterior border of the head.

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Thorax slightly shorter than the head, the posterior lateral angles (Fig. 225 *E*) with a very distinct, free lobe; sternal plate present, small and slender.

Abdomen elongate oval, setae arranged in the normal pattern, few, quite long and slender. *Spiracles* (Fig. 225 *D*) moderately large. *Gonopophyses* (Fig. 225 *G*) elongate, divergent, with a row of setae along the mesal margin; median genital plate lacking; a pair of rather conspicuous crescent-shaped sclerotic areas between the gonopophyses and the apical lobes, the latter very large and prominent.

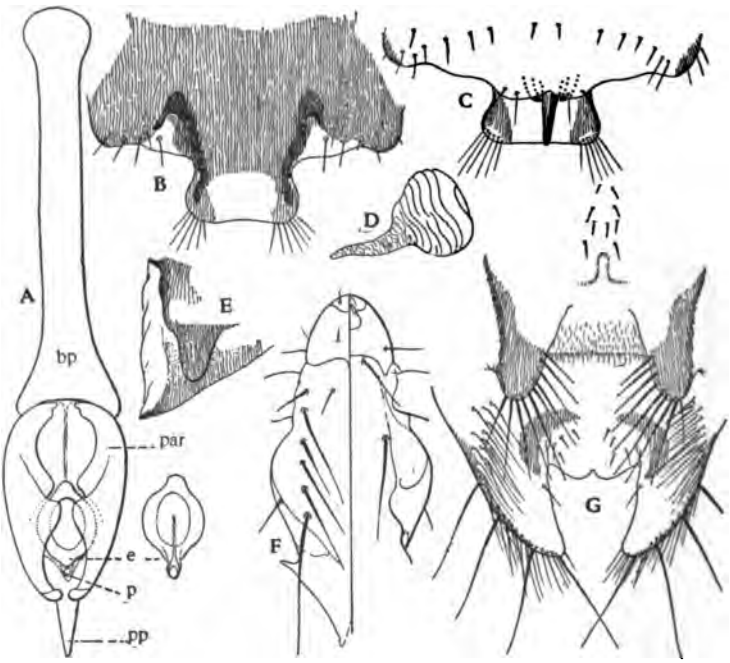

FIG. 225.—*Linognathus fahrenholzi* Paine: *A*, genitalia of male; *B*, ventral aspect of apex of abdomen of male; *C*, dorsal aspect of same; *D*, spiracle; *E*, posterior angle of dorsum of thorax; *F*, head; *G*, genital region of female.

MALE (Fig. 224). Length 2 mm. In general very similar to the female. *Genitalia* (Fig. 225 *A*) with the parameres (*par*) strongly curved, the outline of the two together being broadly oval, each with two broad expansions on the mesal margin which inclose the small and broadly ring-shaped endomeral piece (*e*); apex of the abdomen (Fig. 225 *C*) with the last sternal plate (Fig. 225 *B*) produced into a truncate point.

NOTE.—This species is one of the general type of *L. tibialis*, but the gonopophyses of the female and the genitalia of the male are quite distinctive.

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15. Linognathus hippotragi n. sp.

FIGS. 226, 227

SPECIMENS EXAMINED. Types, a female, allotype, one paratype male and one paratype female, from *Hippotragus niger*, zoölogical garden, Johannesburg, South Africa, G. A. H. Bedford, 1930.

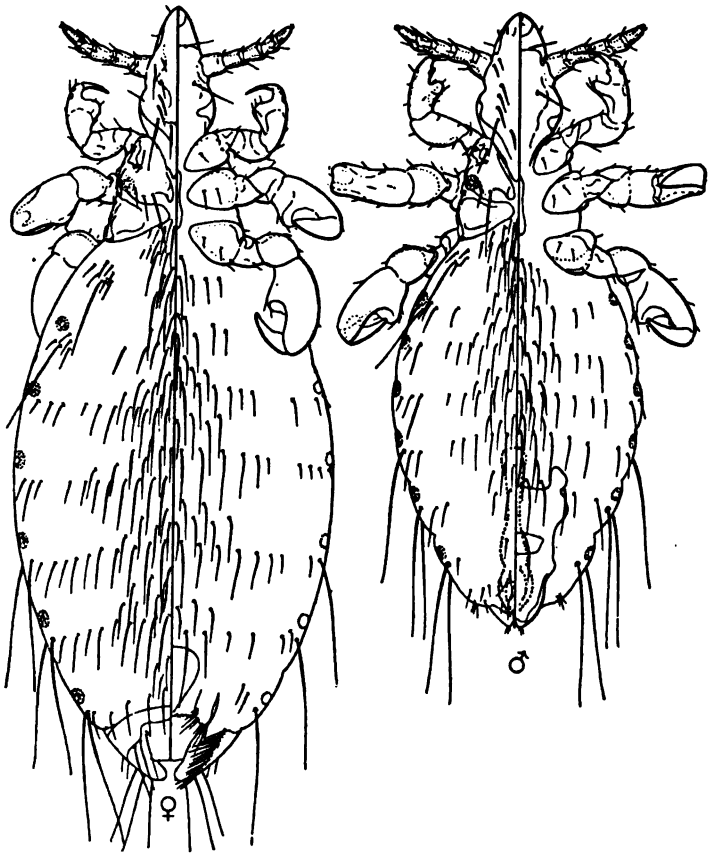

FIG. 226.—*Linognathus hippotragi* n. sp., male and female.

FEMALE (Fig. 226). Length 2.5 mm. *Head* (Fig. 227 *F*) elongate, the antennae set slightly forward of the middle, the fore head acutely parabolic, the hind head with the margins smoothly convex and with strongly defined lateral sclerotic areas, the dorsum of the head sclerotic except for an irregular median area; pharynx (Fig. 227 *D*) with very small brushes, mouth parts not exceeding the posterior margin of the head; dorsal setae large and long.

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Thorax slightly shorter than the head, or ordinary form; sternal plate present, very slender.

Abdomen with the setae arranged in the normal pattern, all quite long and slender. *Spiracles* (Fig. 227 *E*) quite large, the markings very numerous. *Gonopophyses* (Fig. 227 *C*) small, acutely rounded, divergent, their mesal margin with a cluster of rather large setae; median genital plate large and triangular; apical lobes prominent, bearing three or four large setae on the outer margin and a fringe of small setae on the ventral side-

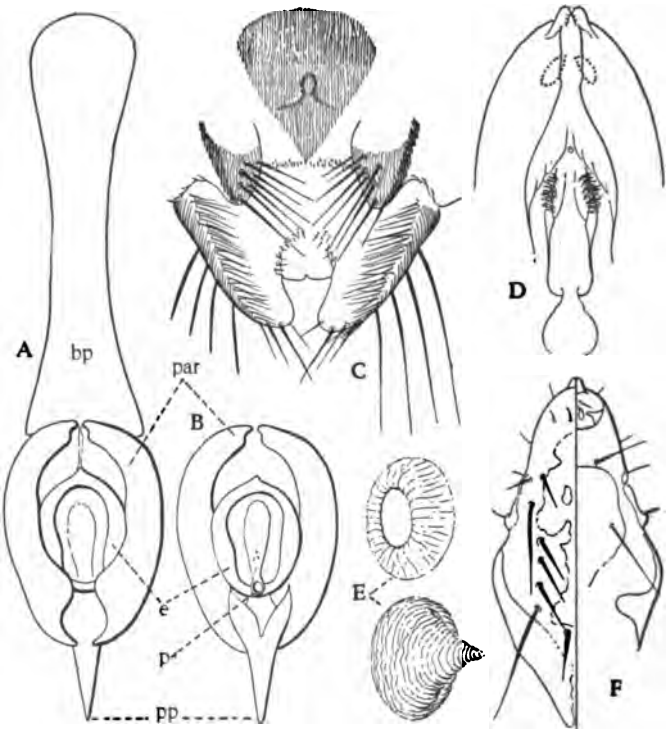

FIG. 227.—*Linognathus hippotragi* n. sp.: *A*, genitalia of male, dorsal aspect; *B*, terminal complex of genitalia, ventral aspect; *C*, genital region of female; *D*, pharyngeal framework; *E*, spiracle; *F*, head.

MALE (Fig. 226). In general quite similar to the female, but with the abdominal setae smaller. *Genitalia* (Fig. 227 *A*, *B*) with the parameres (*par*) together forming a broad oval, each with a rounded expansion on the mesal margin near the apical third, inclosing the broadly ring-shaped endomeral piece (*e*); apex of the abdomen terminating in a broad and slightly emarginate median lobe.

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NOTES.—This species is one of the *tibialis* group but is readily distinguishable from any other. The broad, triangular genital plate of the female is similar to that of *L. gnu*, but the gonopophyses are different and the apex of the abdomen of the male is quite differently formed.

16. Linognathus taurotragus Bedford

FIGS. 228, 229

1927. *Linognathus* sp., Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report*, 11–12: 738.

1927. *Linognathus taurotragus* Bedford, *Transactions of the Royal Society of South Africa*, 14: 347; figs. 1, 2.

PREVIOUS RECORDS. From *Taurotragus oryx*, Clocolan, Orange Free State.

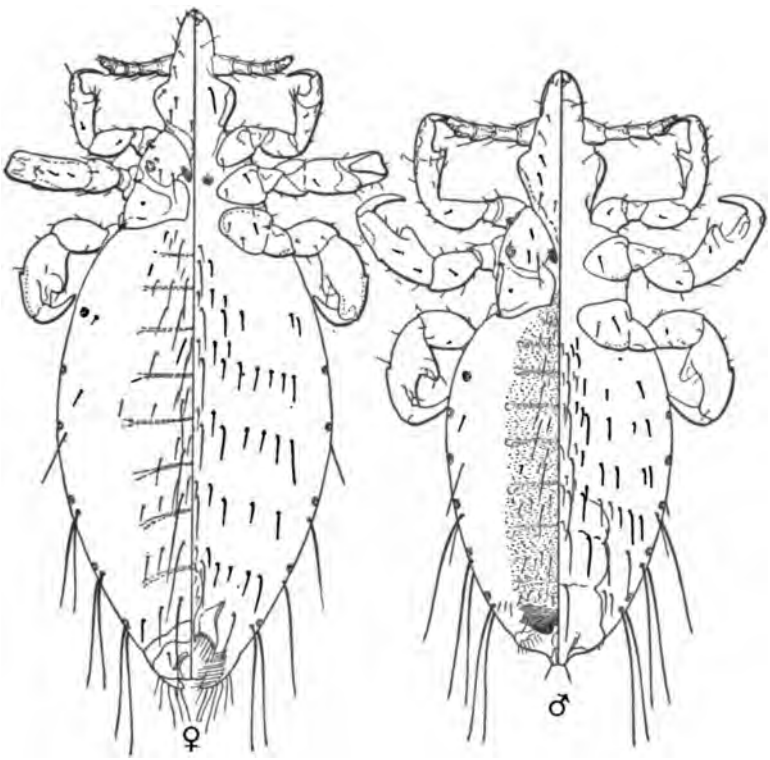

FIG. 228.—*Linognathus taurotragus* Bedford, male and female. From paratypes.

SPECIMENS EXAMINED. Specimens from the type lot, received through the kindness of Mr. Bedford, and others from the same host, Natal, South Africa, received through the kindness of Mr. Lawrence Hill.

FEMALE (Fig. 228). Length attaining 2.5 mm. *Head* (Fig. 229 *C*) strongly pigmented and sclerotic, the antennae set slightly forward of the

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midde, the fore head sharply parabolic, the hind head with the margins strongly and sharply convex; dorsal setae few and small; pharynx (Fig. 229 *B*) without brushes; mouth parts attaining about the middle of the thorax.

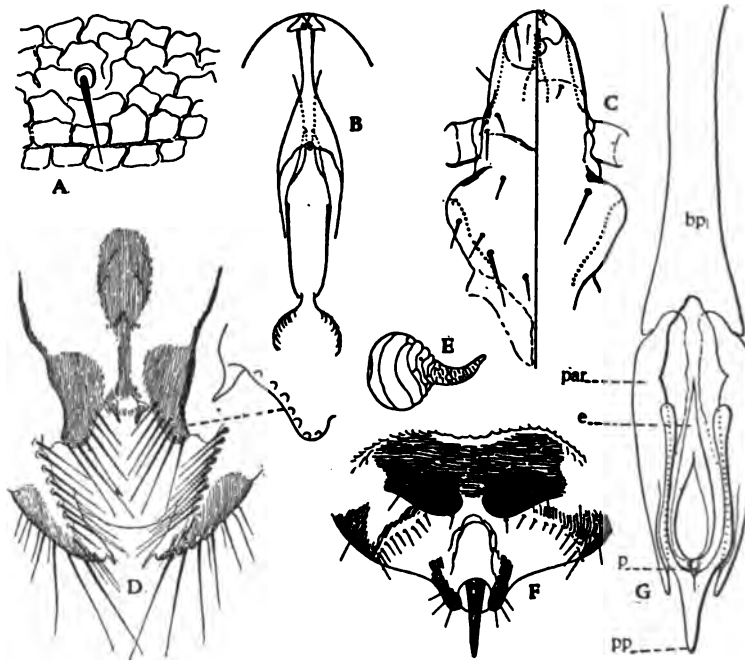

FIG. 229.—*Linognathus taurotragus* Bedford: *A*, ornamentation of derm of abdomen; *B*, pharyngeal framework; *C*, head; *D*, genital region of female; *E*, spiracle; *F*, dorsal aspect of apex of abdomen of male; *G*, genitalia of male.

Thorax somewhat shorter than the head, relatively broad, with the lateral margins divergent posteriorly; sternal plate lacking.

Abdomen elongate oval; setae arranged in the normal pattern but very few and for the most part quite small; derm tending to be somewhat sclerotic, the pattern of reticulations strongly defined, especially in the median region of the dorsum. *Spiracles* (Fig. 229 *E*) small, globular, coarsely ringed. *Gonopophyses* (Fig. 229 *D*) of a very distinctive pattern, tapering and divergent apically, each with a small tongue-like process at the mesal angle, the margin beset with a row of setae; median genital plate present, spatulate; apical lobes moderately prominent, fringed laterally with several moderately large setae and with a short ventral fringe of small setae.

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MALE (Fig. 228). Length 2 mm. Differing from the female in the shorter abdomen and the stronger development of the median sclerotization of the abdominal dorsum; eighth tergite (Fig. 229 *F*) with a conspicuous, bilobed median plate which is deeply pigmented. *Genitalia* (Fig. 229 *G*) with the parameres (*par*) simple and tapering, the endomeral piece (*e*) forming an elongate ring, the pseudopenis (*pp*) with long basal arms; apex of the abdomen with a slight median point.

NOTE.—A very distinct species, not closely resembling any other, although it is probably a member of the *tibialis* group.

17. Linognathus breviceps (Piaget)

FIGS. 216 *A*; 230; 231 *B, C, E, F, H*; 232 *A*

1885. *Haematopinus breviceps* Piaget, *Les Pediculines*, Supplement, p. 142; pl. 15, fig. 5.

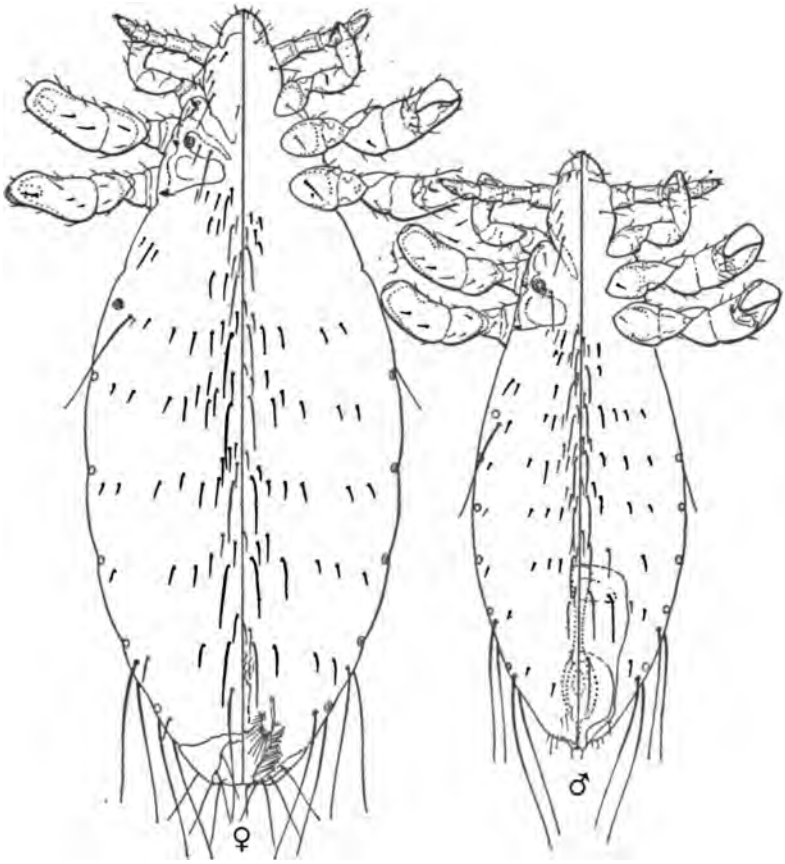

FIG. 230.—*Linognathus breviceps* (Piaget), male and female. From types.

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1908. *Haematopinus breviceps* Piaget, Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 11.

1916. *Linognathus breviceps* (Piaget), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), **6**: 160.

PREVIOUS RECORDS. Known only from the original record by Piaget, from *Cephalophus maxwelli*, without indication of locality.

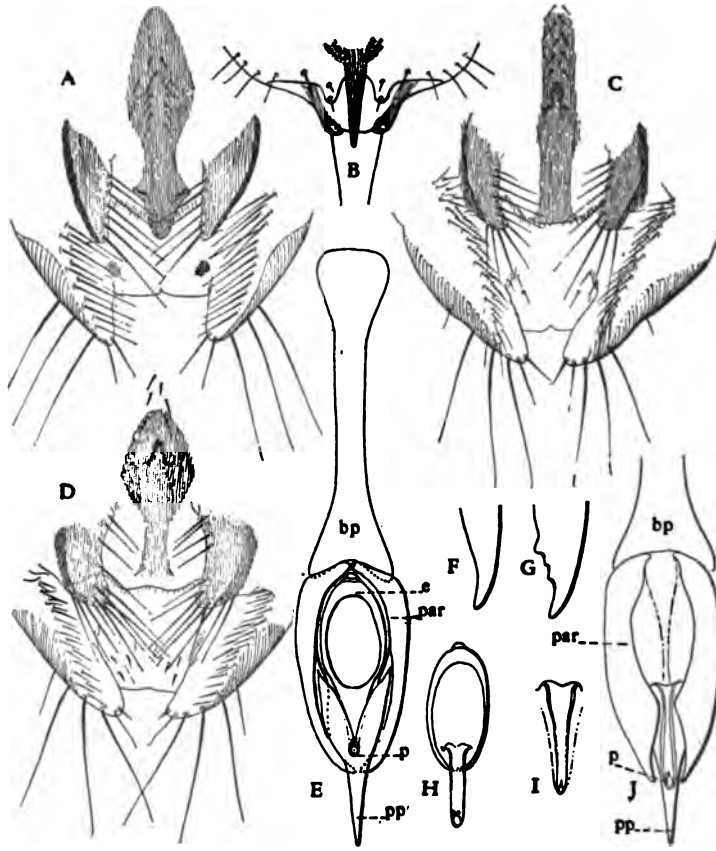

FIG. 231.—*Linognathus limnotragi* Cummings: *A*, genital region of female; *I*, penis; *J*, genitalia of male. *Linognathus breviceps* (Piaget): *B*, dorsal aspect of apex of abdomen of male; *C*, genitalia of female; *E*, genitalia of male; *F*, apex of paramere; *H*, endomeral piece and penis. *Linognathus angulatus* (Piaget): *D*, genital region of female; *G*, apex of paramere.

SPECIMENS EXAMINED. Four females, three males, and three nymphs in the Piaget Collection, mounted on three slides labeled "*Haematopinus breviceps* P. sur un *Cephalophus maxwelli*," and undoubtedly including the types. These slides were remounted by the present writer.

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FEMALE (Fig. 230). Length 1.75 mm. A rather slender and delicate species. *Head* (Fig. 232 *A*) relatively short and broad and quite deeply retracted into the thorax; antennae set very slightly forward of the middle of the head; fore head rounded, with the lateral margins beset with minute tubercles and with very conspicuous, internal, lateral sclerotic areas; hind head with the lateral margins but very slightly and smoothly convex, not at all angulate; pharynx (Fig. 216 *A*) with very slight brushes; mouth parts barely exceeding the length of head.

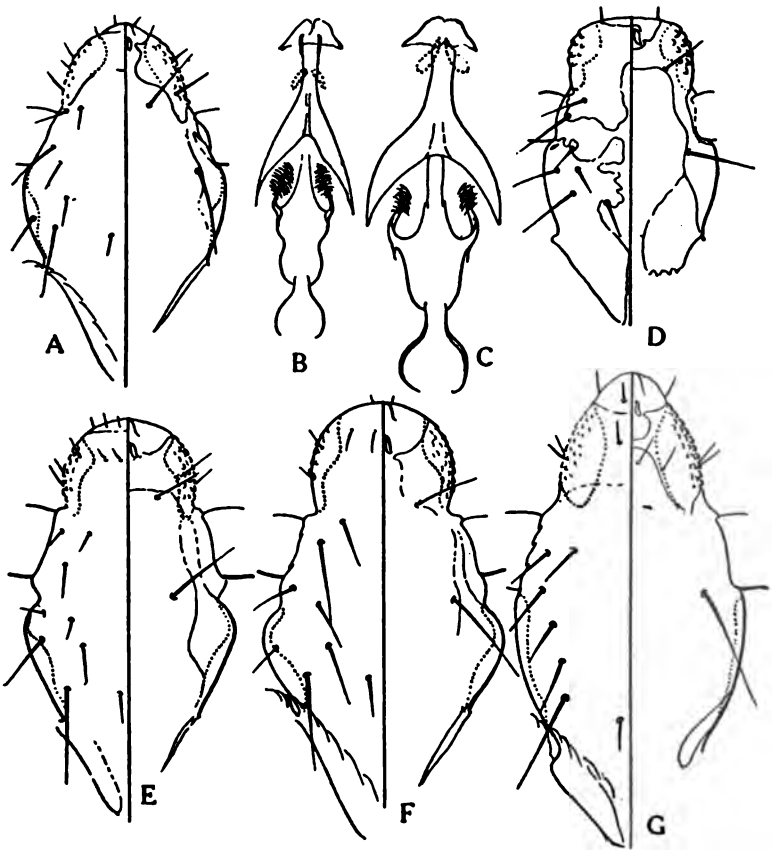

FIG. 232.—Heads: *A, Linognathus breviceps* (Piaget); *E, L. gazella* Mjöberg; *D, L. limnotragi* Cummings; *F, L. "gilvus"* Fahrenholz; *G, L. angulatus* (Piaget). Pharyngeal framework: *B, L. gazella* Mjöberg; *C, L. limnotragi* (Cummings).

Thorax short and broad; sternal plate lacking. Legs not strikingly large. *Abdomen* with the normal pattern of setae, these rather sparse and small except for a median pair on each segment dorsally and ventrally.

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Long marginal setae present on seventh and eighth segments, with a single long seta near the spiracle on the third segment. *Spiracles* small, spherical. *Gonopophyses* (Fig. 231 *C*) small and slender, widely separated, beset with long setae along the apex and the mesal margin; median genital plate somewhat irregular, narrow; vulva strongly convex, the vagina thickly beset with minute spines; apical lobes but moderately prominent, bearing a mesal series of numerous small setae and several long setae on the outer margin.

MALE (Fig. 230). Length 1.25 mm. In general characters closely resembling the female. *Genitalia* (Fig. 231 *E, H*) with the basal plate (*bp*) quite long and slender, the parameres (*par*) strongly curved and inclosing the large, ring-shaped endomeral piece (*e*), the tubular penis (*p*) and the Y-shaped pseudopenis (*pp*), the arms of which are quite strongly expanded and fit into recesses in the parameres. Apex of the abdomen (Fig. 231 *B*) terminating in a slight, truncate process formed by the extension of the ninth sternite.

NOTES.—I have seen no specimens, other than the types, that can definitely be referred to this species. A discussion of the characters by which it may be distinguished from its near relatives will be associated with the description of *L. limnotragi* Cummings.

18. Linognathus angulatus (Piaget)

FIGS. 231 *D, G*; 232 *G*; 233

1885. *Haematopinus ungulatus* Piaget, *Les Pediculines,* Supplement, p. 144; pl. 15, fig. 7. (Probably misprint for *angulatus,* the latter appearing in the description of the plates and on the type labels.)

1908. *Haematopinus ungulatus* Piaget, Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 11.

1916. *Linognathus angulatus* (Piaget), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 160. (Part.)

PREVIOUS RECORDS. Known only from the original description by Piaget, from *Cephalophus nigrifrons,* without indication of locality. Later records purporting to be of this species are erroneous.

SPECIMENS EXAMINED. Two males and a female on two slides in the Piaget Collection (British Museum), labeled "*Haematopinus angulatus* P. sur un *Cephalophus nigrifrons.*" These were remounted by the present writer and may be regarded as the types.

FEMALE (Fig. 233). Length 2.1 mm. A rather stout species which in its general characteristics very closely resembles *L. breviceps* (Piaget) but differs in certain particulars. *Head* (Fig. 232 *G*) slender, the hind head constricted into a slight but distinct neck, the fore head acutely pointed.

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Thorax of ordinary form, the sternal plate lacking, the legs strikingly large and heavy. *Abdomen* sparsely haired as in *L. breviceps*. *Gonopophyses* (Fig. 231 *D*) similar to those of *breviceps* but with the genital plate distinctly spatulate.

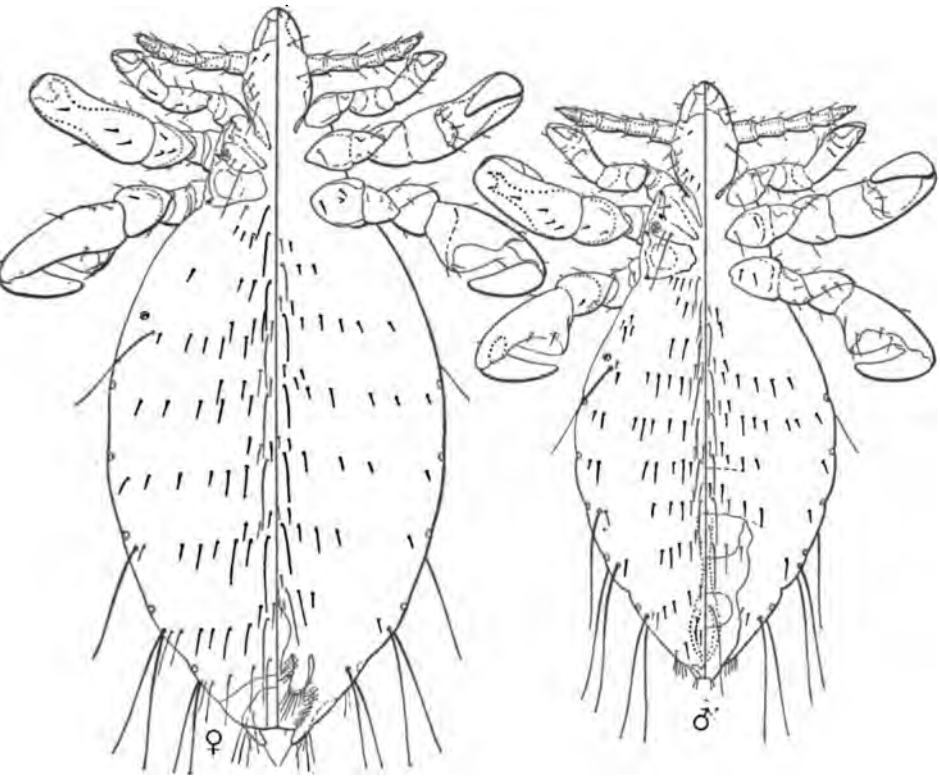

FIG. 233.—*Linognathus angulatus* (Piaget), male and female. From the types.

MALE (Fig. 233). In general quite similar to the female. *Genitalia* apparently identical with those of *breviceps* except that the apices of the parameres (Fig. 231 *G*) are slightly notched.

NOTES,—I have seen no material other than the types that can definitely be referred to this species. It will be discussed further in connection with *L. limnotragi* Cummings.

19. Linognathus gazella Mjöberg

FIGS. 232 *B, E, F;* 234

1910. *Linognathus gazella* Mjöberg, *Arkiv för Zoologi*, **6**: 157–159; fig. 78.
1910. *Linognathus angulatus* (Piaget), Mjöberg, *ibid.*, p. 157. (Misidentification.)

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1916. *Linognathus angulatus* (Piaget), Ferris, *Annals of the Durban Museum*, 1:238. (Misidentification.)
1916. *Linognathus angulatus* (Piaget), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6:160. (Part.)
1916. *Linognathus gazella* Mjöberg, Ferris, *ibid.*, p. 162.
1917. *Linognathus gilvus* Fahrenholz, *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 34: (Beiheft) 2:18; fig. 5. (August.)
1917. *Linognathus gilvus* Fahrenholz, *Zoologischer Anzeiger*, 48:92. (October.)
1927. *Linognathus angulatus* (Piaget), Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report*, 11–12:737. (Misidentification.)

PREVIOUS RECORDS. Described by Mjöberg as *Linognathus gazella* from "gazelle," Hamburg Zoölogical Gardens, and also recorded by him erroneously as *L. angulatus* (Piaget) from *Cephalophus* sp. in the same gardens. These latter specimens were later described by Fahrenholz as *L. gilvus*. Erroneously recorded by Ferris and by Bedford as *L. angulatus* from *Cephalophus natalensis* and *Sylviacapra grimmi* from Zululand and Transvaal.

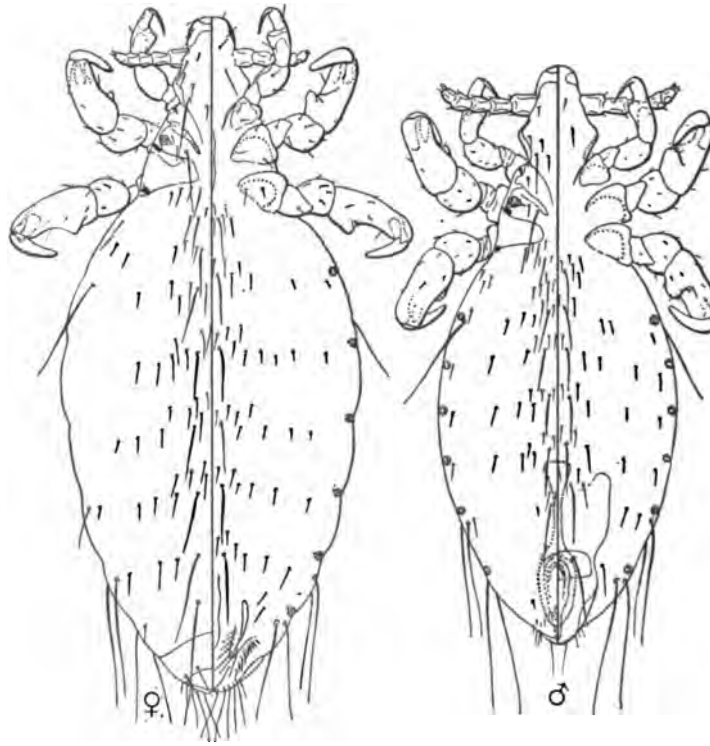

FIG. 234.—*Linognathus gazella* Fahrenholz, male and female. From the types.

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SPECIMENS EXAMINED. Types and co-types of *Linognathus gazella* and *L. gilvus* and specimens from the lots recorded by Ferris and by Bedford.

FEMALE (Fig. 234). Length 2–2.5 mm. In general characters very close to *L. breviceps*. *Head* (Fig. 232 *E, F*) with the lateral margins of the hind head distinctly angulate and constricted into a slight neck; fore head broadly rounded or in some specimens almost truncate; pharynx (Fig. 232 *B*) with small brushes.

Thorax, abdomen, and genitalic region apparently identical with those of *L. breviceps*.

MALE (Fig. 234). Length 1.5 mm. Except for the head form, which is as in the female, practically identical in all respects with the male of *L. breviceps*.

NOTES.—The examination of the types of *L. gazella* Mjöberg and *L. gilvus* Fahrenholz, together with the other material at hand, affords clear evidence that these species cannot be separated. The original figure of the head given by Mjöberg is entirely misleading, the very truncate form of the fore head being illusory. Some specimens tend toward the condition shown by him, but others from the same lots cannot be distinguished from the types of *L. gilvus*. That *L. gazella* should be recognized as distinct from *L. breviceps* is dubious, but this point will be discussed following the description of the next species.

20. Linognathus limnotragi Cummings

FIGS. 231 *A, I, J*; 232 *C, D*

1913. *Linognathus limnotragi* Cummings, *Bulletin Entomological Research*, 4: 36; fig. 1.

1916. *Linognathus limnotragi* Cummings, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 162.

PREVIOUS RECORDS. Known only from the original record, from *Limnotragus* (= *Tragelaphus*) *gratus*, in the Zoölogical Garden of London from the Congo region.

SPECIMENS EXAMINED. The types and other specimens from *Tragelaphus sylvaticus*, Anderstepoort, Pretoria, *G. A. H. Bedford*, and *Tragelaphus scriptus*, Zoölogical Garden, London, *H. H. Scott* (Molteno Institute).

FEMALE. Length 2 mm. Very closely resembling *L. breviceps* in general form but differing in certain details. *Head* (Fig. 232 *D*) quite short and broad, with the fore head almost rectangular; hind head with margins slightly convex and nearly parallel; dorsum with a distinct, irregular, sclerotic pattern.

Thorax and *abdomen* in general practically as in *L. breviceps*, but the genitalic structures differing somewhat. *Gonopophyses* (Fig. 231 *A*) elongate, with setae only along the mesal margin; median genital plate of

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distinctive form, somewhat, as pointed out by Cummings, of the form of the sole of a shoe, the heel continued to the lip of the vulva, which is quite strongly convex.

MALE. Length 1.5 mm. *Head* as in the female. *Genitalia* (Fig. 231 *I, J*) of distinctive form because of the apparently complete absence of the endomeral piece; penis (*p*) (Fig. 231 *I*) quite large, overlying the base of the pseudopenis.

NOTES.—There seems to be no room for doubt as to the distinctness of this species and as to the correctness of assigning to it the specimens here recorded.

THE SPECIES OF THE *L. breviceps* GROUP

The five species just dealt with, *L. breviceps* (Piaget), *L. angulatus* (Piaget), *L. gazella* Mjöberg, *L. gilvus* Fahrenholz, and *L. limnotragi* Cummings, together with some material which must be left unassigned, constitute a puzzling group of forms. The writer himself is by no means entirely satisfied with the treatment here accorded them, and it is possible that future workers with more material available may come to conclusions quite different from those which have here been reached. Certain things, however, appear to be reasonably clear.

There can, in the writer's view, be no doubt that *Linognathus gazella* Mjöberg and *L. gilvus* Fahrenholz are inseparable. The types of the latter and co-types of the former are at hand and reveal nothing to justify a specific distinction. In Fig. 232 *E* is shown a careful camera lucida drawing of the head of a specimen labeled as a co-type of *L. gazella* and in Fig. 232 *F* a similar drawing to the same scale from a specimen labeled as "type" of *L. gilvus*, these specimens having been received as a loan through the kindness of Dr. Titschack of the Hamburg Museum. Other specimens at hand from the type lot of *gazella* show the fore head more nearly rectangular and thus approaching the figure given by Mjöberg, but that figure is evidently exaggerated. It seems perfectly clear that specimens previously recorded by the author and others as *L. angulatus* (Piaget) are referable rather to *L. gazella*.

But whether or not *L. gazella* should be separated from *L. breviceps* is a more dubious matter. Any separation must be based upon the form of the head, for there seems to be nothing else in which they differ in any appreciable degree. In Fig. 232 *A* is shown the head of a specimen from the co-types of *L. breviceps*, this drawn to the same scale as Fig. 232 *E, F, G*. The differences in head form are constant throughout the few specimens of *L. breviceps* and, although trivial, are clear enough upon a direct comparison of specimens. Although the writer is inclined to the view that *L. gazella* should in its turn be merged with *L. breviceps*, that step is not here taken. To do so would complicate the situation for later workers to whom more adequate material may possibly confirm the distinctness of these forms.

There is in the mind of the writer no feeling of doubt in regard to *L. angulatus* (Piaget). This species is apparently quite distinct, although no specimens, other than the types, are at hand. The elongate head, the relatively enormous legs, and the form of the genital plate of the female mark it clearly enough.

The same is true of *L. limnotragi* Cummings. The characters which define it are slight but quite clear. There is some variation in the form of the genital plate of the female, but the absence of the endomeral piece in the genitalia of the male is definite and precise.

Certain specimens at hand from *Aepyceros melampus*, Rustenburg District,

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Transvaal, received from G. A. H. Bedford, must here be left unplaced. They include only females which do not fit exactly with any of the named species, although approaching *L. limnotragi*.

Other doubtful specimens are those once recorded by Cummings[1] quite erroneously as *L. tibialis* (Piaget) var. These specimens are the closest to *L. angulatus* of any that have been examined, but they are in bad condition and cannot be placed more closely.

21. Linognathus pithodes Cummings

FIGS. 235; 238 *D*; 239 *F, G*

1916. *Linognathus pithodes* Cummings, *Proceedings of the Zoölogical Society of London*, p. 260; t. figs. 3–5.

1916. *Linognathus pithodes* Cummings, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 205.

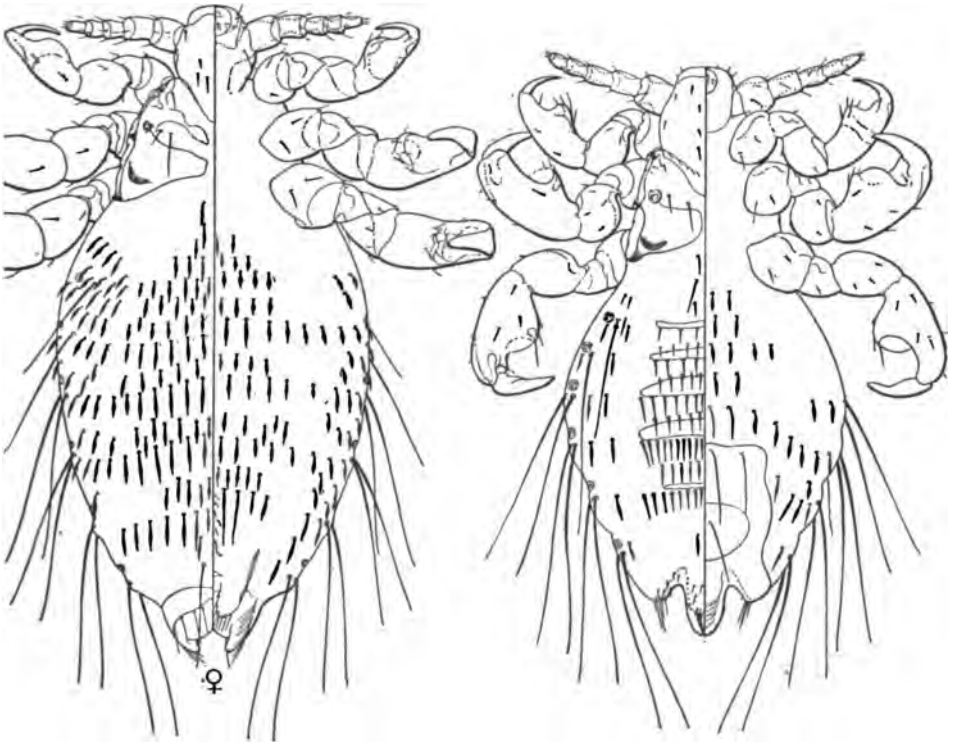

FIG. 235.—*Linognathus pithodes* Cummings, male and female. From the types.

PREVIOUS RECORDS. From *Antilope cervicapra* from India, Zoölogical Society Gardens, London.

[1] B. F. Cummings, *Proceedings of the Zoölogical Society of London*, 1916, pp. 266–267; t. fig. 6.

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SPECIMENS EXAMINED. The type lot.

FEMALE (Fig. 235). Length 1.5 mm. A very robust species. *Head* short and broad (as in Fig. 239 *C*), scarcely longer than wide, with the antennae set well forward and with the fore head almost truncate, the whole head quite sclerotic and with an exceptionally sclerotic band encircling the oral region; buccal funnel and pharynx short and broad, the latter without brushes; mouth parts scarcely exceeding the posterior margin of the head.

Thorax only slightly longer than the head and relatively very broad, the coxae widely separated; sternal plate lacking; posterior lateral angles with a broad free lobe. Legs very large and stout.

Abdomen broadly oval, setae arranged in the normal pattern but distinguished by their lanceolate form (Fig. 239 *F*); margins of the abdomen with a single long seta on segments three and four, and two long setae on segments five to eight. *Spiracles* small, globular, with coarse reticulations. *Gonopophyses* (Fig. 238 *D*) of a distinctive form, broad, leaf-like, set close together, and with a tuft of long setae at the apex; median genital plate lacking except for a very small area at the lip of the vulva; apical lobes short, with a fringe of short setae on the ventral side.

MALE (Fig. 235). Length 1.31 mm. Differing from the female in the character of the abdomen, which bears distinct tergal plates on the third to seventh segments, these occupying about the median third of the abdomen. Apex of the abdomen strongly trilobed. Setae of the abdomen fewer than in the female, those along the tergal plates spike-like in form.

Genitalia (Fig. 239 *G*) spread in the only available specimens, and the parameres thus not directly comparable with those of related species; pseudopenis (*pp*) short and wedge-shaped; endomeral piece (*e*) delicate and forming an oval ring.

NOTES.—This species may be regarded as the type of a small group of forms which includes also *L. bedfordi* n. sp. and *L. spicatus* n. sp. The group is distinguished by the common possession of a short, broad head, broad thorax and abdomen, lanceolate abdominal setae, and the broad, leaf-like gonopophyses of the female. One of the species, *L. spicatus*, differs from all other species of *Linognathus* in having the anterior claw of the same form and almost of the same size as the others, but its relationships are otherwise so obviously with the *pithodes* group that to remove it to a new genus would do violence to the evident facts.

L. pithodes is approached most closely by *L. bedfordi* n. sp., the two being in fact very similar. They differ, however, in certain details, *L. pithodes* having the abdomen more hairy, the gonopophyses more slender and more widely separated, and the genitalia of the male differently formed.

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22. **Linognathus bedfordi** n. sp.

FIGS. 236; 238 *B, C, E, H, I;* 239 *A, B, C, D*

SPECIMENS EXAMINED. One male and one female from ***Antidorcas marsupialis,*** Anderstepoort, Pretoria, South Africa, received through the kindness of G. A. H. Bedford.

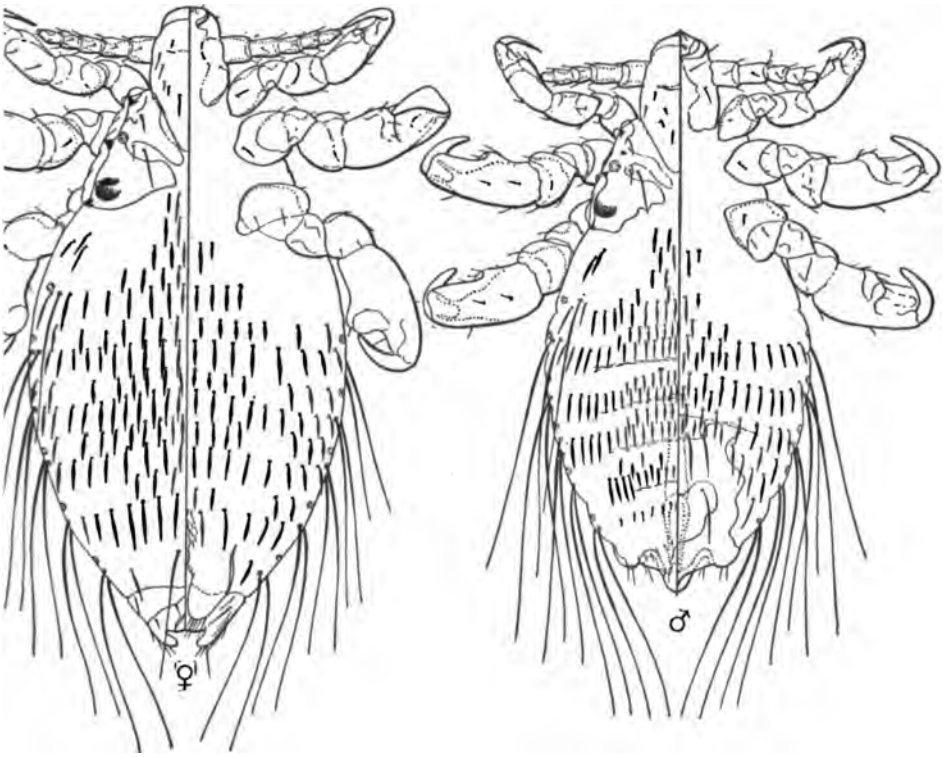

FIG. 236.—*Linognathus bedfordi* n. sp., male and female.

FEMALE (Fig. 236). Length 1.5 mm. In general closely resembling *L. pithodes.* Abdomen with the generically typical arrangement of setae, these slender lanceolate (Fig. 239 *D*); margins of segment three with one and of segments four to eight with two very long setae. *Gonopophyses* (Fig. 238 *E*) very broad and leaf-like, their mesal margins touching, the rounded apex with a tuft of three or four long setae; median genital plate present, very small, linear.

MALE (Fig. 236). Length 1.25 mm. In head and thorax and arrangement of abdominal setae essentially like the female, the rows of abdominal setae perhaps more sharply defined. *Genitalia* (Fig. 239 *A, B*) with the

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terminal complex nearly as long as the basal plate, the parameres (*par*) slender, tapering, set close together, and with a quite conspicuous, membranous, slightly papillate basal lobe; pseudopenis (*pp*) entirely inclosed by the apices of the parameres; endomeral piece (*e*) complexly formed, produced forward into the apical notch of the basal plate; apex of the abdomen (Fig. 238 *H, I*) strongly trilobed.

NOTE.—As indicated under the discussion of *L. pithodes*, these two species are undoubtedly closely related but may be separated by the details of their structure.

23. Linognathus spicatus n. sp.

FIGS. 237; 238 *A, G*; 239 *E*

SPECIMENS EXAMINED. Two females and a male from *Gorgon taurinus*, Maastrom, Northern Transvaal, received through the kindness of G. A. H. Bedford.

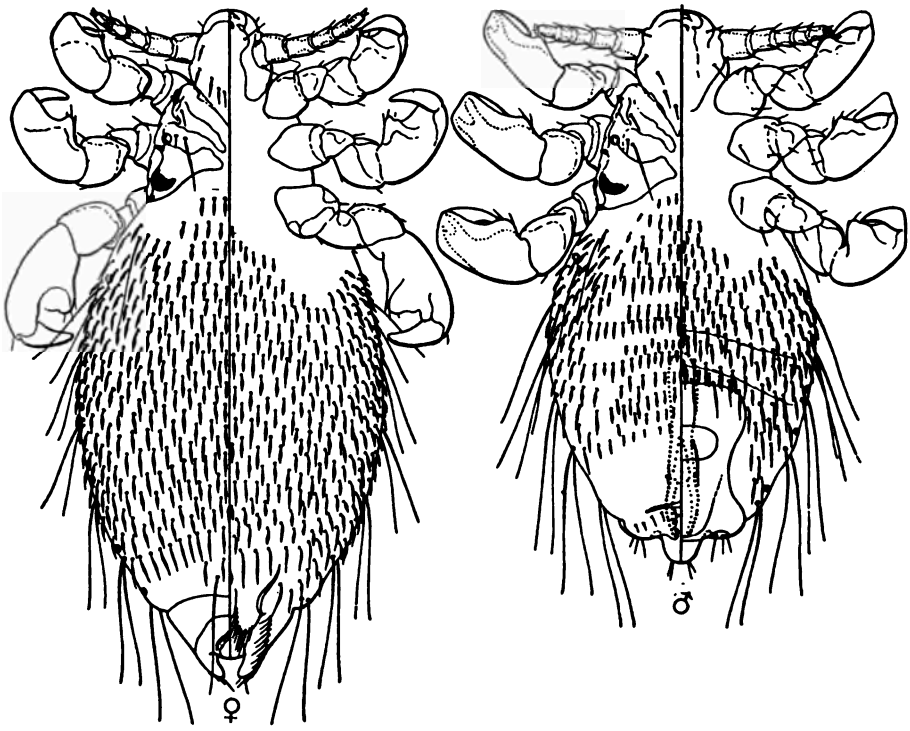

FIG. 237.—*Linognathus spicatus* n. sp., male and female.

FEMALE (Fig. 237). Length 1.75 mm. In general form of the type of *L. pithodes*. Anterior legs, however (Fig. 238 *G*), with the claw stout, being nearly of the same form and size as the claws of the other legs.

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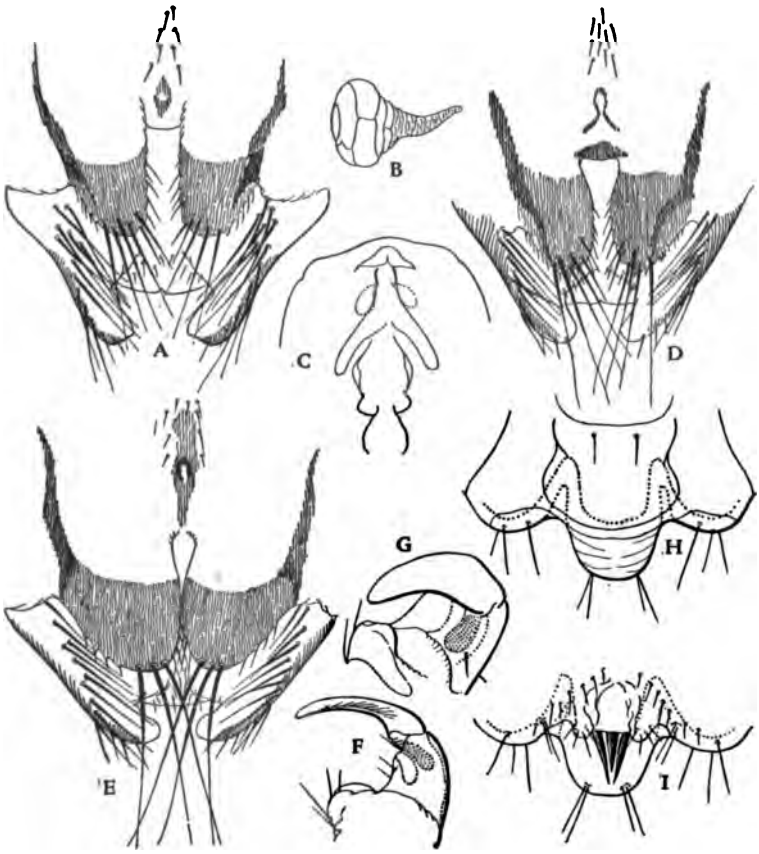
omen almost entirely covered with short, lanceolate setae (Fig. 239 *E*), normal arrangement being entirely obscured; margins of second segment with one and of third to eighth with two long setae. *Gonopophyses* (Fig. 238 *A*) practically as in *L. pithodes;* median genital plate lacking; dorsal lobes apparently more blunt than in *L. pithodes.*



238.—*Linognathus spicatus* n. sp.: *A,* genital region of female; *G,* anterior claw. *L. bedfordi* n. sp.: *B,* spiracle; *C,* pharyngeal framework; *E,* genital region of female; *F,* anterior claw; *H,* ventral aspect of apex of abdomen of male; *I,* dorsal aspect of same. *L. pithodes* Cummings: *D,* genitalia of female.

MALE (Fig. 237). Length 1.25 mm. *Head* and *thorax* as in female. *omen,* however, with fewer setae, the normal arrangement appearing cially on the dorsum. *Genitalia* obscured in the single available speci- but apparently as in *L. bedfordi;* apex of abdomen with the strongly bed form common to the *pithodes* group.

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NOTES.—In some respects, notably the enlarged anterior claw, this species depar[illegible] from the typical form of the genus *Linognathus*. Nevertheless, it is the writer's co[illegible] viction that its obviously close resemblance in other characters to *L. pithodes* and *L. bedfordi* makes its generic separation undesirable.

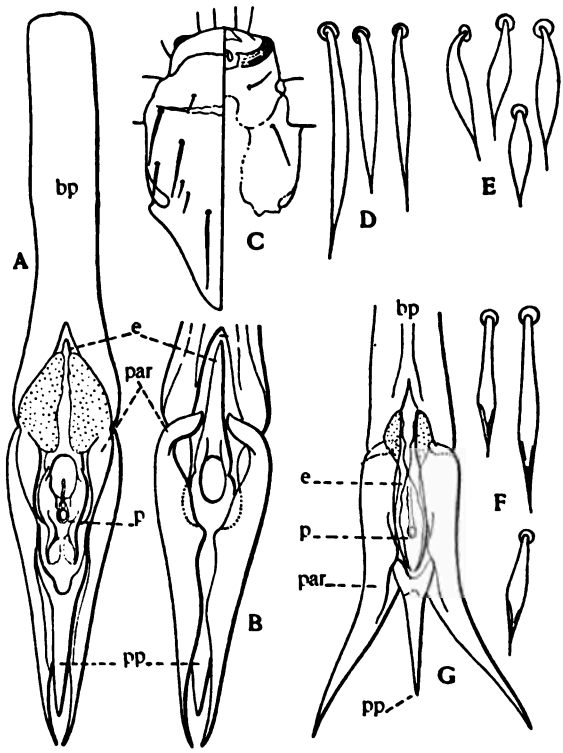

FIG. 239.—*Linognathus bedfordi* n. sp.: *A*, genitalia of male, ventral aspect; *B*, dorsal aspect of terminal complex of genitalia of male; *C*, head; *D*, types of abdominal setae. *L. spicatus* n. sp.: *E*, types of abdominal setae. *L. pithodes* Cummings: *G*, genitalia of male; *F*, types of abdominal setae.

Genus **MICROTHORACIUS** Fahrenholz

1915. Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, **81**: Heft 11: 29.
1929. Ewing, *Manual of External Parasites*, p. 136.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; with the head extraordinarily enlarged and elongated, forming nearly half the total length of the body; with the thorax greatly reduced in size, but retaining all the normal parts, the anterior coxal condyles crowded beneath the head, the mesothoracic phragmata continuous across the dorsum and obliterating the true notum, the sternal

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plate lacking; pleural plates entirely lacking; abdomen membranous throughout except for the usual ninth tergite and the genital areas; abdominal setae numerous, not arranged in definite rows; apex of the abdomen of the female without ventral lobes; spiracles present on the third to eighth abdominal segments.

HOSTS. Known only from members of the family Camelidae, Order Artiodactyla.

TYPE OF THE GENUS. *Haematopinus* (*Linognathus*) *praelongiceps* Neumann.

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS

NOTE.—Names in italics are synonyms of the names with which they are coupled.

cameli (Linnaeus).
Pediculus cameli Linnaeus.
Haematopinus cameli (Linnaeus).
Haematopinus tuberculatus (Burmeister) (misidentification, part).
praelongiceps (Neumann).
Haematopinus (*Linognathus*) *praelongiceps* Neumann.
Linognathus praelongiceps (Neumann).

NOTES.—Although the members of this little genus are obviously related to *Linognathus* it would be unduly conservative to retain them in the latter. It is probable that the two species included represent the entire complement of the genus, the host family having within it but six living species.

1. **Microthoracius praelongiceps** (Neumann)

FIGS. 240, 241

1909. *Haematopinus* (*Linognathus*) *praelongiceps* Neumann, *Archives de Parasitologie,* **13**: 508; figs 10–12.
1916. *Linognathus praelongiceps* (Neumann), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 164.
1916. *Microthoracius praelongiceps* (Neumann), Fahrenholz, *Archiv für Naturgeschichte,* Abt. A, **81**: Heft 11: 30.

PREVIOUS RECORDS. Known only from the original description, from "*Auchenia huanaca,* Choquecomato, Bolivia."

SPECIMENS EXAMINED. A female from the type lot (Molteno Institute) and a male and four females from *Auchenia llama,* Zoölogical Park, Washington, D.C., U.S.A. (U.S.N.M.).

FEMALE (Fig. 240). Length 3.5 mm. *Head* forming almost half the total length of the body, cylindrical, with the antennae set at about the anterior fourth, the fore head acute; hind head slightly swollen just behind the antennae and with a faint, transverse sclerotic area in this region; occiput deeply inserted into the thorax; dorsal setae few, small, and

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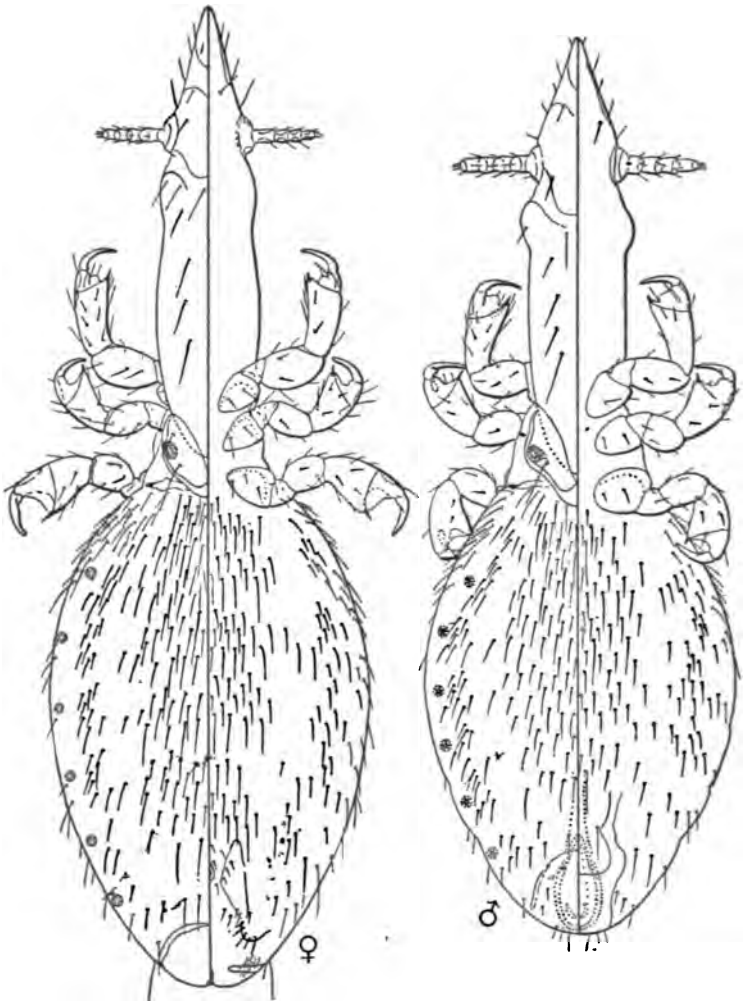

FIG. 240.—*Microthoracius praelongiceps* (Neumann), male and female. From specimens from *Auchenia llama*, Zoölogical Park, Washington, D.C.

slender; buccal funnel and pharynx (Fig. 241 *D*) very slender and delicate, the latter without brushes; "mandibles" lacking, the oral region ventrally with a small, transverse lobe (Fig. 241 *D*). *Antennae* (Fig. 241 *F*) relatively very small, the first segment short and broad, the two sensoria which usually are found on the two last segments here both on the terminal segment.

Thorax (Fig. 241 *C*) relatively very small, the condyles of the anterior coxae crowded beneath the head, the mesothoracic phragma continuous

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across the dorsum, the true notum entirely obliterated; tibia and tarsus of anterior leg (Fig. 241 *G*) slightly more slender, but actually somewhat larger, than those of the other two pairs, all claws slender.

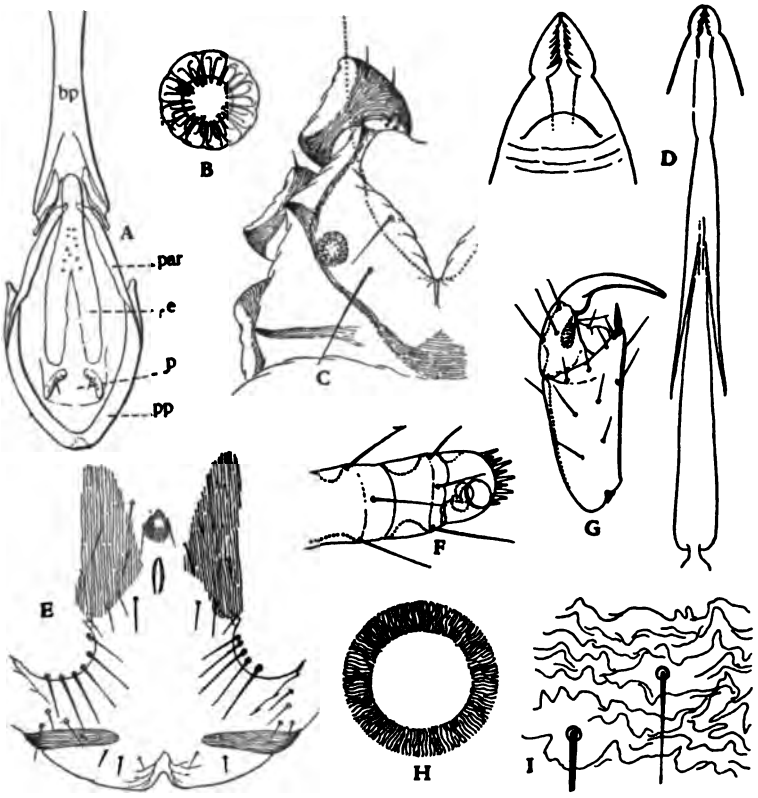

FIG. 241.—*Microthoracius praelongiceps* (Neumann): *A*, genitalia of male; *B*, spiracle; *C*, dorsum of thorax; *D*, pharyngeal framework and details of apex of head; *E*, genital region of female; *F*, apex of antenna; *G*, anterior tibio-tarsus; *H*, spermatheca; *I*, ornamentation of derm of abdomen.

Abdomen with the derm throughout minutely wrinkled (Fig. 241 *I*) and beset with numerous small, fine setae which are not arranged in definite rows and which leave narrow longitudinal areas bare both dorsally and ventrally. Tergal plate of ninth segment very narrow and ill-defined, extending somewhat to the ventral side. *Spiracles* (Fig. 241 *B*) of peculiar form, globular, the inside beset with relatively large, finger-like processes. *Gonopophyses* (Fig. 241 *E*) very small, rounded, bearing a few small setae along the margin. Genital plate represented by two parallel sclerotic areas; opening of spermathecal duct surrounded by a

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sclerotic ring; ventral apical lobes entirely lacking. *Spermatheca* in the form of a ring, which has its walls set with taenidia-like threads (Fig. 241 *H*).

MALE (Fig. 240). Length 2 mm. In general very similar to the female. Tergal plate of ninth segment practically obsolete. *Genitalia* (Fig. 241 *A*) of a distinctive type, the basal plate (*bp*) quite small, the parameres (*par*) slender and strongly divergent, articulating with the tips of the arms of the very large U-shaped pseudopenis (*pp*); endomeres represented apparently by a flat central piece (*e*) and the penis by two small pieces (*p*), which seem to surround an opening. Genital plate very small, lyriform; apex of the abdomen smoothly rounded.

NOTE.—It is possible that this species is not really distinct from *M. cameli* (Linnaeus), but this cannot be determined until the latter has been rediscovered.

2. Microthoracius cameli (Linnaeus)

FIG. 242

1668. *Piddochio del cammelo,* Redi, *Esperienze intorno alla generatione degl' insetti,* pl. 20.
1758. *Pediculus cameli* Linnaeus, *Systema Naturae* (ed. 10), p. 611.
1844. *Pediculus cameli* Linnaeus, Gervais, in Walckenaer, *Histoire naturelle des insectes aptères,* 3: 306.
1874. *Haematopinus cameli* (Linnaeus), Giebel, *Insecta Epizoa,* p. 47.
1880. *Haematopinus cameli* (Linnaeus), Piaget, *Les Pediculines,* p. 644.
1908. *Haematopinus ? cameli* (Linnaeus), Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum,* p. 11.
1909. *Haematopinus tuberculatus* (Burmeister), Neumann, *Archives de Parasitologie,* 13: 499. (Misidentification.)
1911. *Haematopinus tuberculatus* (Burmeister), Neumann, *ibid.,* 14: 413–414.
1916. *Haematopinus tuberculatus* (Burmeister), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 146. (Part, misidentification.)
1916. *Microthoracius cameli* (Linnaeus), Fahrenholz, *Archiv für Naturgeschichte,* Abt. A, 81: (Heft) 11: 30.

PREVIOUS RECORDS. Apparently known only from the figure given by Redi (1668).

NOTES.—The figure given by Redi, upon which Linnaeus based the name *Pediculus cameli,* is surprisingly good, being in fact better than many figures that have been published within very recent years, and in addition the insect is so peculiar as to leave no doubt concerning its generic position. The credit for recognizing its proper place belongs to Fahrenholz (1916). Earlier authorities—notably Neumann—labored under a conviction that it must be some species of *Haematopinus.* In fact Neumann, in spite of having at hand specimens of the closely similar *M. praelongiceps* (Neumann), characterized Redi's figure as "tellement fantaisiste," and persisted in attempts to identify *Pediculus cameli* with *Haematopinus tuberculatus* (Burmeister). The present writer accepted Neumann's conclusions and listed

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Pediculus cameli as a synonym of *Haematopinus tuberculatus* in his catalogue of the Anoplura (1916). Fortunately his ignorance of the rules of nomenclature induced him to forego the step of suppressing the name *tuberculatus* as should have been done if such an assignment were correct.

It remains for someone having access to camels to rediscover the species before its actual distinctness from *C. praelongiceps* can be established. The figure here presented is a facsimile reproduction of that given by Redi.

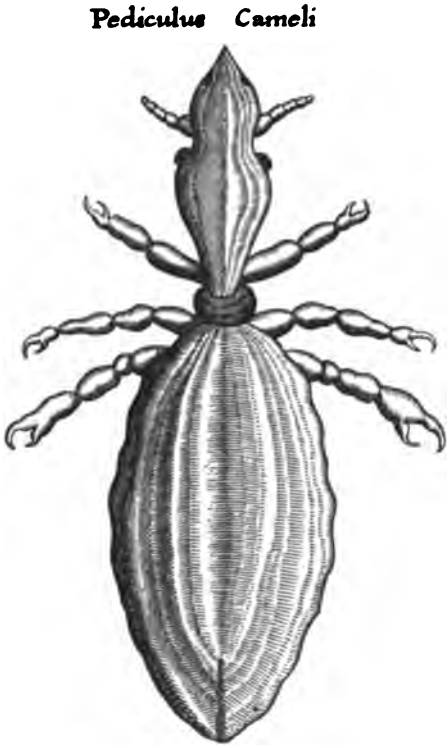

FIG. 242.—*Microthoracius cameli* (Linnaeus). Reproduction of the figure by Redi, from the first Latin translation of his work, 1671.

Genus **SOLENOPOTES** Enderlein

1904. *Solenopotes,* Enderlein, *Zoologischer Anzeiger,* **28**: 143.
1908. *Solenopotes,* Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 15.
1909. *Haematopinus* (*Solenopotes*), Neumann, *Archives de Parasitologie,* **13**: 530.
1915. *Cervophthirius,* Mjöberg, *Entomologisk Tidskrift,* **36**: 282.
1916. *Linognathus,* Ferris, *Entomological News,* **27**: 199.
1916. *Linognathus,* Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 159.

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1916. *Linognathus*, Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, 81: (Heft) 11:24.
1921. *Solenopotes*, Bishopp, *Journal of Agricultural Research*, 21:797.
1927. *Solenopotes*, Freund, *Prager Archiv für Tiermedizin*, 7A:215.
1929. *Solenopotes*, Ewing, *Manual of External Parasites*, pp. 136, 139.
1929. *Cervophthirus*, Ewing, *ibid.*, p. 136.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; anterior legs slender, with slender claw, middle and posterior legs stout, with stout, heavy claw; pleural plates entirely lacking; abdomen membranous throughout except for the usual ninth tergite and the genital areas; spiracles borne each on a more or less prominent sclerotic tubercle and usually somewhat tubular; abdominal setae arranged in distinct rows, with but one row to each tergite and sternite; thorax with the pleurites forming practically the entire dorsum, the propleurites united by a narrow, sclerotic yoke, the phragmata of the mesopleurites separated medially only by a narrow area which may take the form of an invaginated apophysis; sternal plate present, filling the greater part of the space between the coxae; spermatheca present, its opening into the uterus surrounded by a sclerotic scar; apex of the abdomen of the female ventrally with a pair of flattened, strongly sclerotic, and more or less attenuated and spine-like lobes or processes; genitalia of the male of no constant generic type, but the genital plate characteristically lyriform.

Hosts. One species on domestic cattle and the remainder on members of the family Cervidae (the deer) of the Order Artiodactyla.

Type of the Genus. *Solenopotes capillatus* Enderlein.

Synonymical List of Names Previously Used in the Genus

Note.—Names in italics are synonyms of the name with which they are coupled. The genus *Cervophthirius* here being regarded as a synonym of *Solenopotes*, the names used in the former are treated as if used in the latter.

binipilosus (Fahrenholz).
Linognathus binipilosus Fahrenholz.
Linognathus breviceps (Piaget). (Misidentification.)
Linognathus coassus Fahrenholz.
Linognathus panamensis Ewing.
burmeisteri (Fahrenholz).
Pediculus crassicornis Nitzsch. (Not of Scopoli.)
Haematopinus crassicornis (Nitzsch).
capillatus Enderlein.
Linognathus vituli (Linnaeus). (Misidentification.)
coassus (Fahrenholz).
Solenopotes binipilosus (Fahrenholz).
crassicornis (Nitzsch). (Not of Scopoli.) (Part.)
Solenopotes burmeisteri (Fahrenholz).

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crassicornis (Nitzsch). (Misidentification.)
Solenopotes ferrisi (Fahrenholz).
ferrisi (Fahrenholz).
Cervophthirius crassicornis (Nitzsch). (Misidentification.)
Linognathus ferrisi Fahrenholz. (Not of Bedford.)
panamensis (Ewing).
Solenopotes binipilosus (Fahrenholz).
tarandi (Mjöberg).
Cervophthirius tarandi Mjöberg.
Linognathus tarandi (Mjöberg).

NOTES.—The genus *Solenopotes* was originally based largely upon the character of the abdominal spiracles, which in the type species are borne within prominent, sclerotic tubercles. The present writer at one time mistakenly and quite without justification assumed that its type species, *S. capillatus* Enderlein, is a synonym of *Linognathus vituli* (Linnaeus) and in his catalogue of the Anoplura (1916) suppressed the genus. But that the genus is valid cannot be doubted. The material at hand, however, indicates that its definition must be expanded.

The genus *Cervophthirius* was instituted by Mjöberg for the reception of a single species, *C. tarandi* Mjöberg, and to it was later added a species identified by the writer as *Pediculus crassicornis* Nitzsch. Fahrenholz, however, has regarded *Cervophthirius* as a synonym of *Linognathus*. In naming his new genus Mjöberg compared it with *Solenopotes*, to which he considered it to be most closely related. The comparison was justified, for the evidence at hand indicates the desirability of uniting the two. To maintain them as distinct is simply to obscure the actual facts concerning the relationships of the species involved.

The extraordinary spiracular tubercles of *Solenopotes capillatus* are simply an exaggeration of a condition which appears to some degree in the other species here referred to the same genus. The community of characters is such as to leave little ground for doubt that the genus as here constituted is in fact a natural group. The most precise, although by no means the only, character separating it from *Linognathus* is to be found in the dorsum of the thorax, the true notum being entirely suppressed except for a small point between the ends of the mesothoracic phragmata, the propleurites being united by a sclerotic yoke. In all the species of *Linognathus* the thoracic pleurites are distinctly separated. A comparison of Figs. 215 *B* and 244 *A* will make this clear. Other not so precise characters separating the two genera are to be found in the single rows of abdominal setae, although this is approximated in some species of *Linognathus*, in the sclerotic apical processes of the female and in the lyriform genital plate of the male, although this last is to be seen in *Linognathus pedalis*.

All but one of the species of the genus are from deer. The writer is inclined to the view that the remaining species, *S. capillatus*, which is now known only from domestic cattle, was originally a deer-infesting form which has transferred to cattle and that it will eventually be found upon some Cervid.

1. **Solenopotes capillatus** Enderlein

FIGS. 243, 244

1904. *Solenopotes capillatus* Enderlein, *Zoologischer Anzeiger*, 28: 144; figs. 14–15.
1908. *Solenopotes capillatus* Enderlein, Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 15.

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1916. *Linognathus vituli* (Linnaeus), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 166. (Part; misidentification.)
1916. *Linognathus vituli* (Linnaeus), Ferris, *Entomological News,* **27**: 199. (Misidentification.)
1918. *Solenopotes capillatus* Enderlein, Freund, *Naturwissenschaftliche Zeitschrift Lotos,* **66**: 40–41.
1920. *Solenopotes capillatus* Enderlein, Freund, *Zentralblatt für Bakteriologie und Parasitenkunde,* (I), **84**: 142–148; fig.
1921. *Solenopotes capillatus* Enderlein, Bishopp, *Journal of Agricultural Research,* **21**: 797–801; 6 t. figs.
1923. *Solenopotes capillatus* Enderlein, Pillers, *Veterinary Journal,* **79**: 162–164; 5 t. figs.
1924. *Solenopotes capillatus* Enderlein, Freund, *Prager Tierärztlicher Archiv,* **4A**: 64–66; t. fig. 12.
1927. *Solenopotes capillatus* Enderlein, Freund, *Prager Archiv für Tiermedizin,* **7A**: 47–48; t. fig. 9.
1927. *Solenopotes capillatus* Enderlein, Freund, *ibid.,* **7A**: 215–227; 3 t. figs.
1929. *Solenopotes capillatus* Enderlein, Kohn, *ibid.,* **9A**: 60.
1929. *Solenopotes capillatus* Enderlein, Ewing, *Manual of External Parasites,* p. 139; fig. 76.

Previous Records. From domestic cattle, Germany, England, United States.

Specimens Examined. From domestic cattle; United States, *Bishopp,* and Nova Scotia, *Nova Scotia Agricultural College* (Stanford University).

Female (Fig. 243). Length 1.75 mm. *Head* (Fig. 244 *D*) comparatively short and broad, the antennae set far forward, and the short fore head, broadly rounded, the lateral margins of the hind head nearly straight and somewhat convergent; entire head slightly sclerotic, with a transverse dorsal suture between the bases of the antennae, with a heavily sclerotic transverse band across the front of the dorsum and extending slightly to the ventral side and with a strongly sclerotic area on each lateral margin of the hind head ventrally; occiput but little produced into the thorax; dorsal setae numerous and quite large; pharynx (Fig. 244 *C*) without brushes; antennae with a sensorium on each of the last two segments.

Thorax (Fig. 244 *A*) with the sclerotic areas of the apparent dorsum arranged in a distinctive pattern; the essential features are to be found in the close approximation of the mesal margins of the propleurites and their union by a sclerotic yoke (Fig. 244 *B*) and in the continuity of the mesopleural phragmata, which inclose medially a small, invaginated area that probably represents the last vestige of the true notum. Posterior lateral angles of the dorsum with a small, but distinct, free lobe. Sternal plate present, filling most of the space between the coxae, somewhat

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hexagonal in shape. *Legs* presenting no unusual characters, the fore legs with a slender claw, the middle and posterior legs with tarsus and tibia closely fused and enlarged and with stout claw.

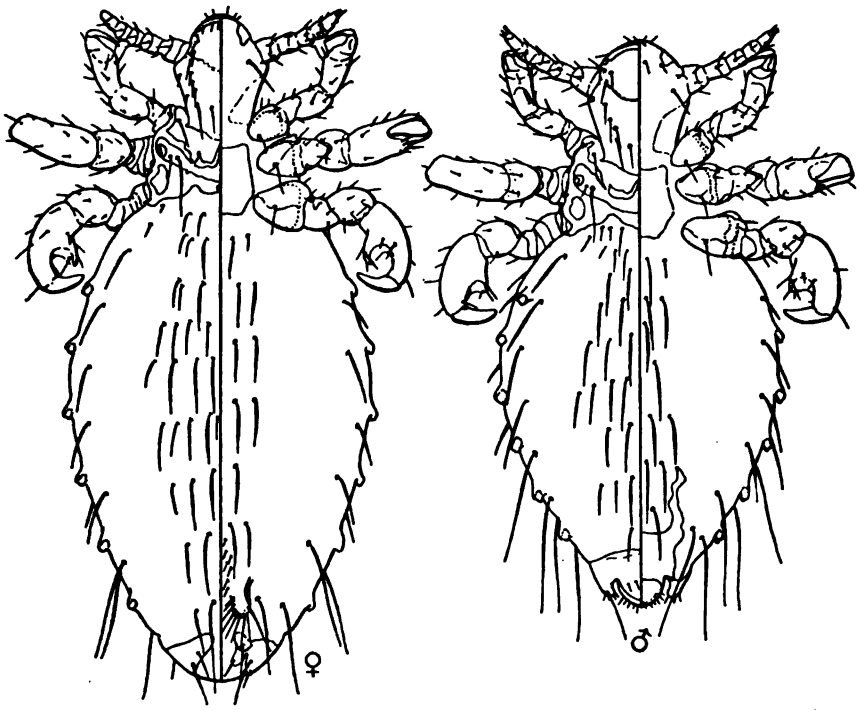

FIG. 243.—*Solenopotes capillatus* Enderlein, male and female.

Abdomen with the derm membranous throughout except for the spiracular tubercles, the ninth tergite and the genital areas. Each segment with a single transverse row of setae, dorsally and ventrally, the dorsal row with a median cluster of four to ten setae, the ventral row with for the most part four median setae, and each segment with a submarginal seta both dorsally and ventrally. *Gonopophyses* (Fig. 244 *F*) small, rounded apically, their apical margin with numerous minute serrations and with several slender setae; median genital plate lacking; apical lobes flattened and sclerotic, terminating in a slender, setiform process.

Spiracles (Fig. 244 *E*) elongate, their walls with transverse furrows, and borne each within a strongly sclerotic, prominent tubercle, these abdominal tubercles constituting the most distinctive character of the species.

MALE (Fig. 243). Length 1.25 mm. In general rather closely resembling the female. *Genitalia* (Fig. 244 *G*) of a distinctive form, the

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parameres (*par*) slender and nearly straight and appearing as if broken by a thin, weak portion; pseudopenis (*pp*) very large, broadly U-shaped; endomeral piece apparently lacking; penis (*p*) borne at the apex of an elongate, flattened piece which may be regarded as the statumen penis.

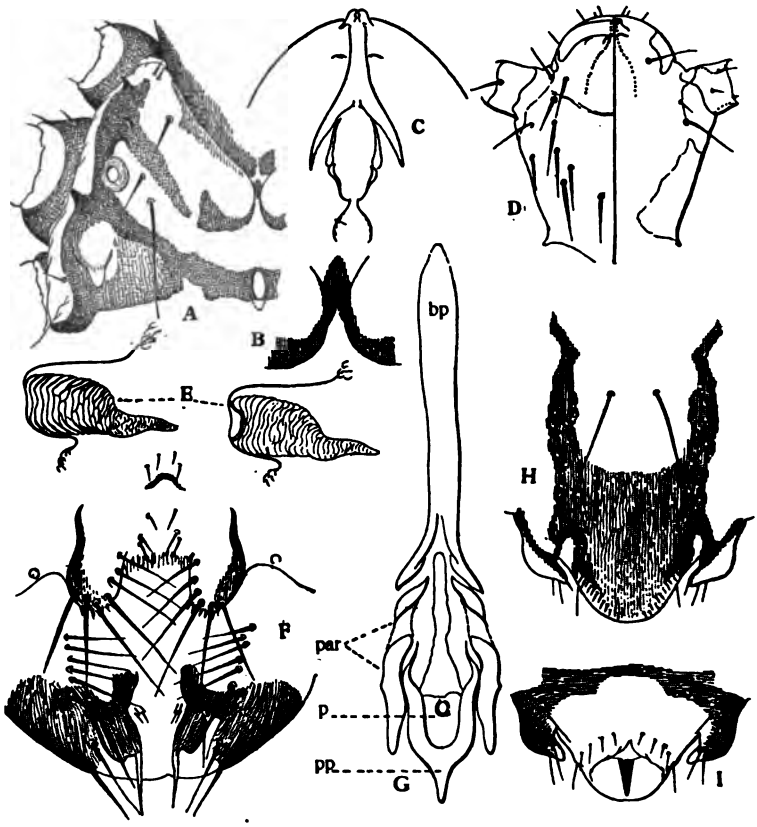

FIG. 244.—*Solenopotes capillatus* Enderlein: *A*, dorsum of thorax; *B*, yoke between propleurites; *C*, pharyngeal framework; *D*, head; *E*, different aspects of an abdominal spiracle; *F*, genital region of female; *G*, genitalia of male; *H*, genital plate of male; *I*, dorsal aspect of apex of abdomen of male.

Apex of the abdomen (Fig. 244 *I*) of peculiar form, strongly trilobed, the lateral lobes sclerotic and somewhat hooked; genital plate (Fig. 244 *H*) lyriform.

NOTES.—It is the writer's view that the features of this species which have in the past been seized upon as a basis for the genus *Solenopotes* are merely exaggerated specific characters, which appear in other species as well but in less extreme form. With such a form as *Solenopotes binipilosus* (Fahrenholz) at hand, it is evident that

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S. capillatus is not an especially isolated species, and we have a clear transition to the entirely ordinary type.

It is further the writer's belief that *S. capillatus* is not normal to domestic cattle but has been derived by them from some Cervid host, and the prediction is here hazarded that it will eventually be found as a normal parasite of some species of the family Cervidae.

2. Solenopotes binipilosus (Fahrenholz)

FIGS. 245, 246

1910. *Linognathus angulatus* (Piaget), Mjöberg, *Arkiv för Zoologi*, **6**: 157. (Misidentification.)
1916. *Linognathus binipilosus* Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, **81**: Heft 11: 11–14; t. figs. 11–13. (August.)
1916. *Linognathus binipilosus* Fahrenholz, *Zoologischer Anzeiger*, **58**: 91. (October.)
1916. *Linognathus coassus* Fahrenholz, *ibid.*, **58**: 92. (October.)
1916. *Linognathus coassus* Fahrenholz, *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, **34**: (Beiheft) 2.
1927. *Linognathus panamensis* Ewing, *Proceedings of the Entomological Society of Washington*, **29**: 119–120.

PREVIOUS RECORDS. Originally described by Fahrenholz from specimens from "Mazama Hirsch" (*Reducina* or *Mazama* sp.), without indication of locality, the host, however, being of a Central or South American genus. Described again by Fahrenholz as *Linognathus coassus* from *Coassus* sp., Hamburg Zoölogical Garden, the host again belonging to a South American genus. Described by Ewing as *Linognathus panamensis* from *Odocoileus chiriquensis*, Panama.

SPECIMENS EXAMINED. The types of *Linognathus coassus* Fahrenholz and other specimens from "Mazama Hirsch, Hamburg Zool. Gart. **21**: II: 1911, Zool. Ges. ded. **15**: VII: 1915," from the collections of the Hamburg Museum, received as a loan through the kindness of Dr. E. Titschack. Several females from *Odocoileus chiriquensis*, Panama Canal Zone, 1921, received through the kindness of L. H. Dunn.

FEMALE (Fig. 245). Length 2 mm. *Head* (Fig. 246 *J*) very similar to that of *S. capillatus*, but somewhat more acute anteriorly, and with the dorsal setae fewer and smaller. The oral region (Fig. 246 *C*) is peculiar because of the development of a labium-like structure which lies between the so-called mandibles and the lateral condyles by which the "mandibles" are ordinarily supported. Pharynx without brushes. Antennae without the sensoria which are normally present on the last two segments (Fig. 246 *G*).

Thorax (Fig. 246 *A*) of the same type as in *S. capillatus*, the propleura united by a sclerotic yoke (Fig. 246 *B*); mesothoracic phragmata not quite united, leaving a small median space. Sternal plate (Fig. 246 *E*) filling most of the space between the coxae, somewhat elongate pentagonal.

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Abdomen with a median cluster of from two to eight setae on each tergite and with two long and two very small setae in a median cluster on each sternite. *Gonopophyses* (Fig. 246 *H*) broad and rounded, with a fringe of long setae; median genital plate lacking; apical lobes forming a pair of sclerotic, flat, tapering, and slender processes.

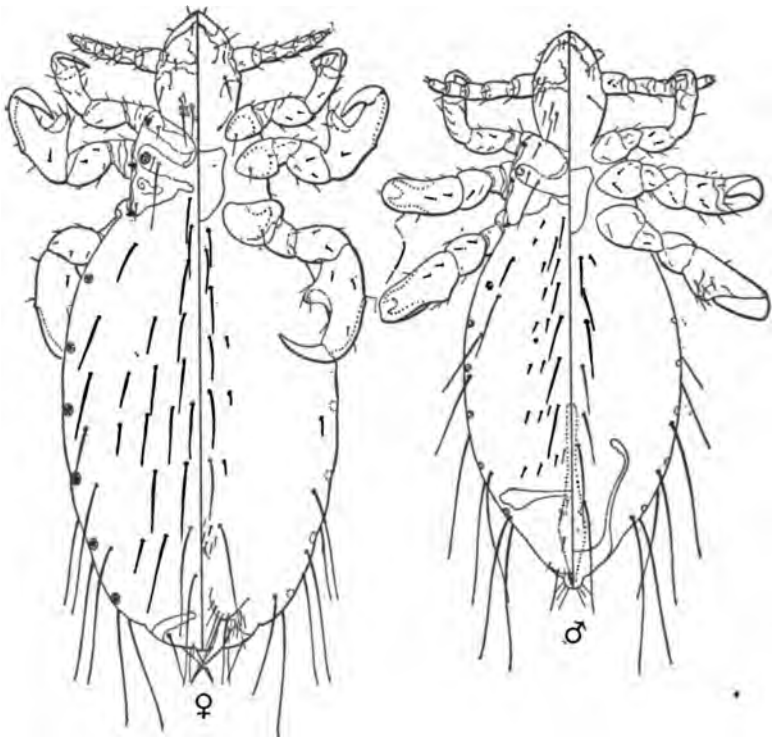

FIG. 245.—*Solenopotes binipilosus* (Fahrenholz), male and female. From specimens from *Odocoileus chiriquensis*, Panama.

Spiracles (Fig. 246 *D*) of the same type as in *S. capillatus*, but shorter and broader, borne within short but perfectly distinct sclerotic tubercles which can be clearly seen if the spiracles are in the proper position.

MALE (Fig. 245). Length 1.5 mm. In general quite closely resembling the female, but with the abdominal setae fewer and in part very small. Eighth tergite (Fig. 246 *I*) with a narrow, transverse, sclerotic area. *Genitalia* (Fig. 246 *K, L*) with the parameres (*par*) large, tapering, set close together and with a portion of the mesal margin of each toward the base excavated; pseudopenis apparently lacking; penis (*p*) borne at the apex of a small plate which may represent the endomeres or the enlarged statumen penis. Genital plate (Fig. 246 *F*) lyriform.

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NOTES.—There appears to be absolutely no reason for the separation of *S. binipilosus* (Fahrenholz) and *S. coassus* (Fahrenholz). The apical lobes of the female are somewhat shorter and less filiform in the latter, but the difference is at most slight. Specimens at hand from the type host and locality of *Linognathus panamensis* Ewing leave no room for doubt as to the status of this species also.

The spiracular tubercles in this species are short but in favorable specimens are perfectly distinct and obviously form a connecting link with the extreme development seen in *S. capillatus*.

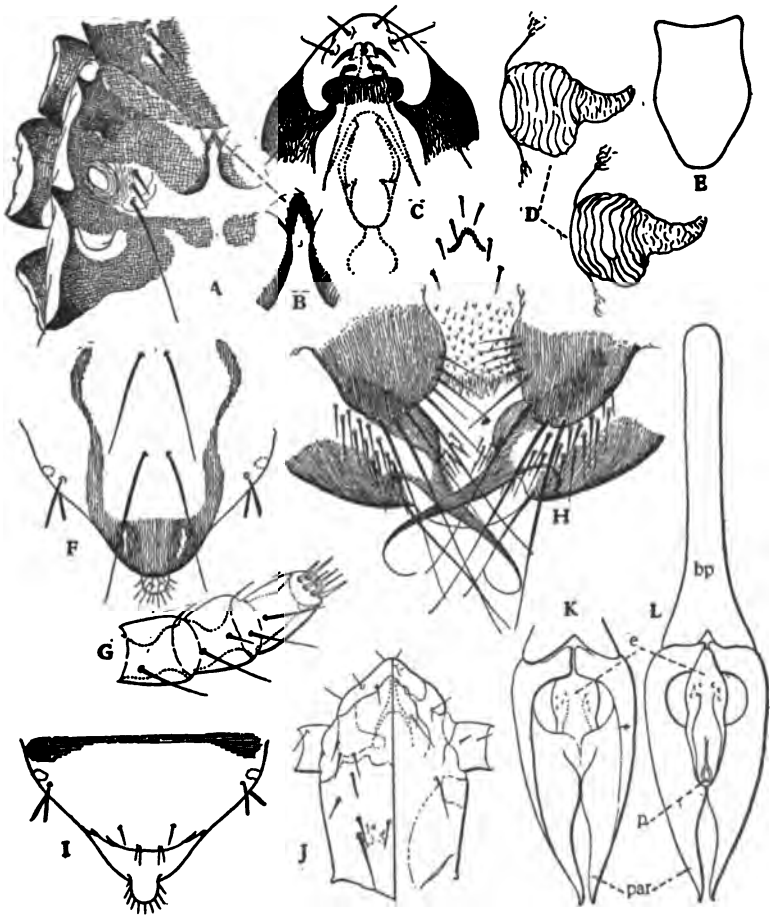

FIG. 246.—*Solenopotes binipilosus* (Fahrenholz): *A*, dorsum of thorax; *B*, yoke connecting propleurites; *C*, ventral aspect of apex of head; *D*, different aspects of abdominal spiracle; *E*, sternal plate; *F*, genital plate of male; *G*, apex of antenna; *H*, genital region of female; *I*, dorsal aspect of apex of abdomen of male; *J*, head; *K*, *L*, aspects of genitalia of male.

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3. **Solenopotes ferrisi** (Fahrenholz)

FIGS. 247, 248, 249 *C*

1916. *Cervophthirius crassicornis* (Nitzsch), Ferris, *Entomological News,* 27: 197-200; figs. (Misidentification.)

1916. *Cervophthirius crassicornis* (Nitzsch), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 167. (Part.)

1919. *Linognathus ferrisi* Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover,* 5–10: 24.

PREVIOUS RECORDS. Recorded by Ferris from *Odocoileus columbianus,* Laytonville, Mendocino County, California. These specimens will stand as the types of the species.

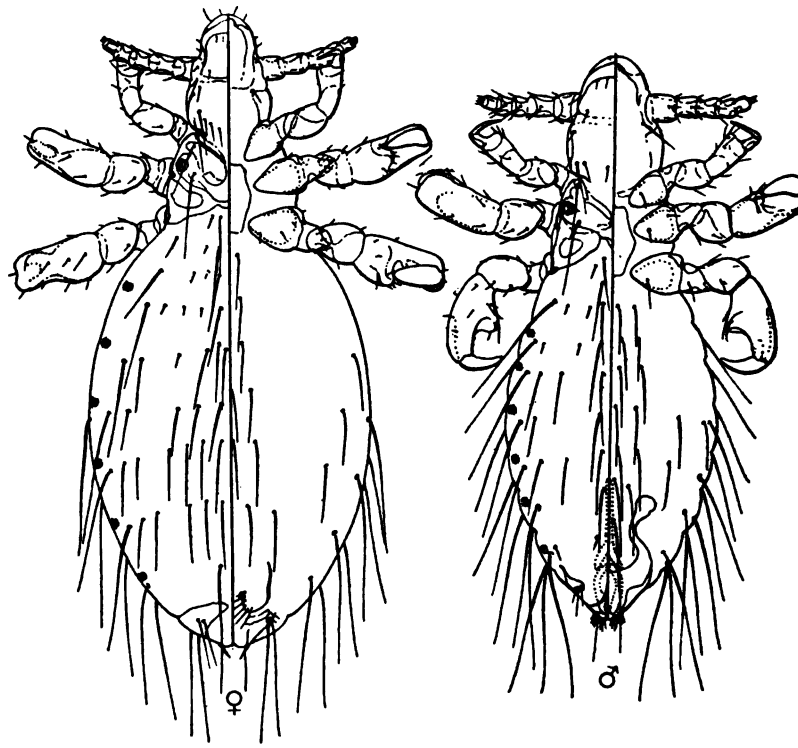

FIG. 247.—*Solenopotes ferrisi* (Fahrenholz), male and female.

SPECIMENS EXAMINED. Those upon which the foregoing record was based and others from the same host, San Gregorio, California.

FEMALE (Fig. 247). Length 1.75 mm. *Head* (Fig. 248 *F*) differing from the two preceding species in having the occipital region narrowed

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into a neck, distinct posterior-lateral angles being present. In other respects it is essentially as in the preceding species and has the same labium-like structure as in *S. binipilosus*. Pharynx (Fig. 248 *G*) without brushes.

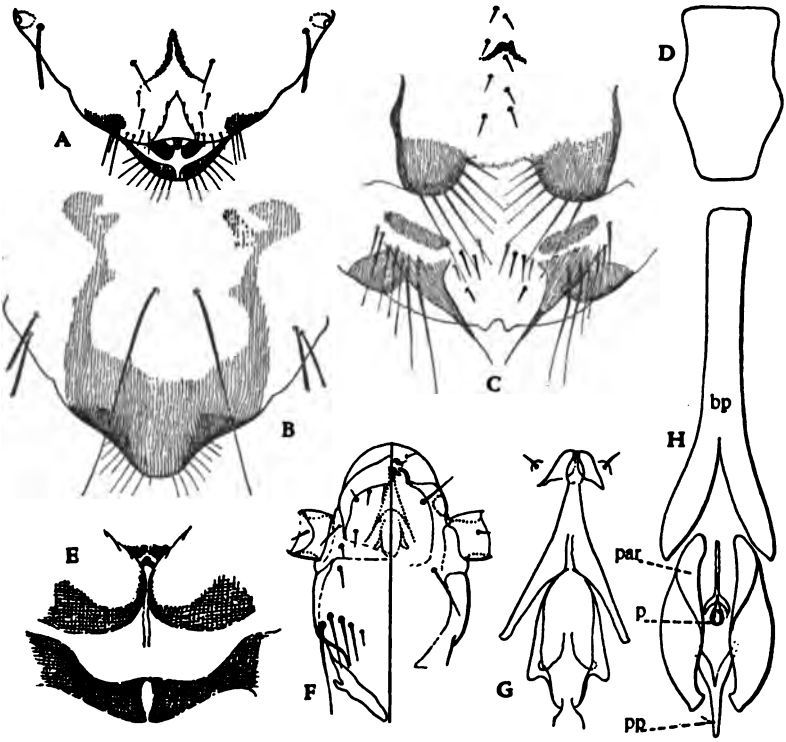

FIG. 248.—*Solenopotes ferrisi* (Fahrenholz): *A*, dorsal aspect of apex of abdomen of male; *B*, genital plate of male; *C*, genital region of female; *D*, sternal plate; *E*, median portion of dorsum of thorax; *F*, head; *G*, pharyngeal framework; *H*, genitalia of male.

Thorax with the characteristic dorsal pattern of the genus, the propleura (Fig. 248 *E*) united by a narrow yoke, the mesothoracic phragmata inclosing a very small median area which probably represents the true notum. Sternal plate (Fig. 248 *D*) in the form of an elongate rectangle with the sides slightly produced, filling most of the space between the coxae.

Abdomen more hairy than in the two preceding species, there being two or more submarginal setae on most of the segments. *Gonopophyses* (Fig. 248 *C*) very small and short, broadly rounded, sclerotic only at the margins, which bear a series of setae; apical lobes short and spike-like;

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between each apical lobe and the corresponding gonopod a small, sclerotic area; median genital plate lacking. *Spiracles* globular, borne within a very slight, sclerotic tubercle.

MALE (Fig. 247). Length 1.25 mm. In general very similar to the female but slightly less hairy. *Genitalia* (Fig. 248 *H*) with the basal plate (*bp*) deeply bifid at the posterior end; parameres (*par*) broad and stout; pseudopenis (*pp*) present, very small; penis (*p*) borne at the apex of a very small and narrow plate, which may be regarded as the statumen penis. Genital plate (Fig. 248 *B*) lyriform. Apex of the abdomen (Fig. 248 *A, B*) with a broad median lobe.

NOTES.—This species was identified by the present writer as the *Pediculus crassicornis* of Nitzsch. Fahrenholz, however, upon what additional evidence does not appear, considered this determination to be erroneous and gave to the species its present name. Whether or not it will stand remains to be determined. It is evidently very similar to *S. tarandi* (Mjöberg). In fact, as far as the description and figures of the latter are concerned the two are identical. Unfortunately specimens of *S. tarandi* are not available for examination.

The form of the head separates *S. ferrisi* readily from *S. capillatus* and *S. bimpilosus.*

4. Solenopotes tarandi (Mjöberg)

1915. *Cervophthirius tarandi* Mjöberg, *Entomologisk Tidskrift,* **36**: 283–285; t. figs. 1–4.

1916. *Cervophthirius tarandi* Mjöberg, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), **6**: 168.

PREVIOUS RECORDS. Known only from the original record, from *Rangifer tarandus,* the "rein deer," Sweden.

NOTES.—Unfortunately specimens of this species are not available. The original description and figures omit some details, but as far as they go the characters clearly indicated—head form, chaetotaxy, form of the genital plate of the male—agree exactly with those of *S. ferrisi* (Fahrenholz).

5. Solenopotes burmeisteri (Fahrenholz)

FIG. 249 *A, B, D*

1818. *Pediculus crassicornis* Nitzsch, *Germar's Magazin der Entomologie,* **3**: 305. (Not of Scopoli.)

1842. *Haematopinus crassicornis* (Nitzsch), Denny, *Monographia Anoplurorum Britanniae,* p. 36.

1874. *Haematopinus crassicornis* (Nitzsch), Giebel, *Insecta Epizoa,* p. 41; pl. 2, fig. 7.

1880. *Haematopinus crassicornis* (Nitzsch), Piaget, *Les Pediculines,* p. 644.

1908. *Haematopinus crassicornis* (Nitzsch), Dalla Torre, *Wytsman's Genera Insectorum,* p. 11.

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1916. *Linognathus crassicornis* (Nitzsch), Fahrenholz, *Zoologischer Anzeiger,* 47: 272.

1916. *Linognathus crassicornis* (Nitzsch), Fahrenholz, *Archiv für Naturgeschichte,* Abt. A, 81: (Heft) 11: 34.

1916. *Cervophthirius crassicornis* (Nitzsch), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 167. (Part.)

1916. *Cervophthirius crassicornis* (Nitzsch), Ferris, *Entomological News,* 27: 197. (Part.)

1919. *Linognathus burmeisteri* Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover,* 5–10: 23.

1929. *Linognathus crassicornis* (Nitzsch), Kohn, *Prager Archiv für Tiermedisin,* 9A: 60.

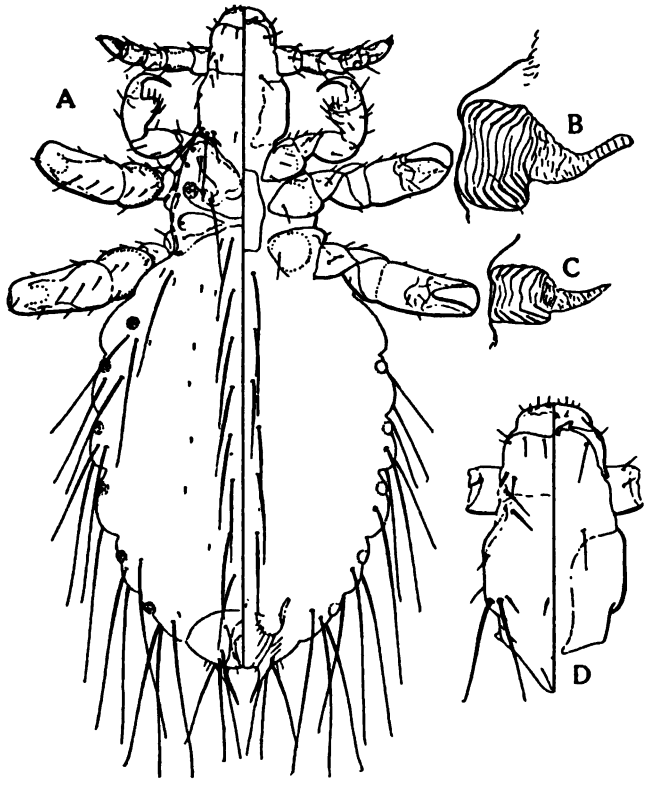

FIG. 249.—*Solenopotes burmeisteri* (Fahrenholz): *A,* female; *B,* abdominal spiracle; *D,* head. *Solenopotes ferrisi* (Fahrenholz): *C,* abdominal spiracle.

PREVIOUS RECORDS. Known only from the original record, from the red deer, *Cervus elaphus,* of Europe and from records by Kohn from the roe deer, *Capreolus caprea,* from Czechoslovakia.

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SPECIMENS EXAMINED. Three females from "reh," *Capreolus caprea,* Czechoslovakia, received as a loan through the kindness of Dr. F. G. Kohn of Karlsbad.

FEMALE (Fig. 249). Length of expanded specimen on slide 2.5 mm. In all respects practically identical with *S. ferrisi* (Fahrenholz). The *head* (Fig. 249 *D*) is of the same form, but slightly more slender and with a slightly different arrangement of the sclerotic areas of the fore head. The *thorax, sternal plate,* and *legs* are as in *S. ferrisi.* The *genitalia* of the female are so nearly identical with those of *S. ferrisi* that the figure presented for the latter (Fig. 248 *C*) could as well have been made from a specimen of *S. burmeisteri.*

The chaetotaxy of the abdomen, however, is somewhat different, there being but two long median setae on each segment, both dorsally and ventrally, and the lateral margins of segments five to eight having three very long and slender setae. The *spiracles* (Fig. 249 *B, C*) of the abdomen are about twice as large as in *S. ferrisi.*

NOTES.—The identification of the specimens at hand as *S. burmeisteri* cannot be positive, for they are not from the type host, and there may possibly be slight differences which would separate them. As far as the female is concerned the species may be regarded as distinct from *S. ferrisi* (Fahrenholz), although the differences are scarcely greater than might well come within the limits of normal variation.

Genus **PROLINOGNATHUS** Ewing

1929. *Prolinognathus,* Ewing, *Manual of External Parasites,* pp. 136, 201.

Anoplura without eyes; with the antennae not sexually dimorphic, appearing four-segmented because of the close fusion of the last two segments, which, however, bear the normal sensoria; anterior legs slender and with slender claw, middle and posterior legs with the tibio-tarsus stout and with stout claw; thorax with the notum entirely suppressed, the propleurites as well as the mesopleurites united across the meson; sternal plate lacking; paratergal plates of the abdomen lacking; abdomen membranous throughout except for the usual ninth tergite and genital structures; abdominal segments each with but a single row of setae, both dorsally and ventrally; gonopophyses well developed, their apices free; spiracles present on the third to eighth abdominal segments.

HOSTS. Known only from members of the family Procaviidae of the order Perissodactyla.

TYPE OF THE GENUS. The *Pediculus Caviae Capensis* (or *Hyracis Capensis*) of Pallas, which, as will be shown below, should be written as *Linognathus caviae-capensis* Cummings.

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NOTES.—While this genus is exceedingly close to *Linognathus* and its separation must be accomplished upon rather small characters, its establishment is probably justified. The only essential differences from *Linognathus* are to be found in the fusion of the two terminal segments of the antennae and the complete obliteration of the notum of the thorax. Ewing (1929, p. 201) makes the extraordinary statement that the thoracic sternum is "reduced and divided transversely into three small plates." It is difficult to understand the basis for such a statement, since the sternum is entirely lacking.

The genus contains but two species.

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS

NOTE.—Names in italics are synonyms of the names with which they are coupled.

caviae-capensis (Cummings).
Pediculus Caviae Capensis Pallas (or *Hyracis Capensis* Pallas).
Haematopinus leptocephalus (Ehrenberg). (Part; misidentification.)
Linognathus caviae-capensis Cummings.
leptocephalus (Ehrenberg).
Pediculus leptocephalus Ehrenberg.
Haematopinus leptocephalus (Ehrenberg). (Part.)
Linognathus leptocephalus (Ehrenberg).

1. Prolinognathus caviae-capensis (Cummings)

FIGS. 250 *A*; 251 *A, E, F, G, H, I, J*

1767. *Pediculus Caviae Capensis* Pallas, *Spicilegia Zoologica*, Fasc. 2: 32; figs. 12, 13.
1874. *Haematopinus leptocephalus* (Ehrenberg), Giebel, *Insecta Epizoa*, p. 47. (Part; misidentification.)
1880. *Haematopinus leptocephalus* (Ehrenberg), Piaget, *Les Pediculines*, p. 656. (Part; misidentification.)
1908. *Haematopinus leptocephalus* (Ehrenberg), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 11.
1913. *Linognathus caviae-capensis* (Pallas), Cummings, *Bulletin of Entomological Research*, 4: 37–39; figs. 2, 3.
1916. *Linognathus caviae-capensis* (Pallas), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences*, (4), 6: 161.
1916. *Linognathus caviae-capensis* (Pallas), Cummings, *Proceedings of the Zoölogical Society of London*, pp. 257–259; fig. 1.
1919. *Linognathus caviae-capensis* (Pallas), Bedford, *Director of Veterinary Research, Union of South Africa, Report*, 5–6: 714.
1927. *Linognathus caviae-capensis* (Pallas), Bedford, *Director of Veterinary Education and Research, Union of South Africa, Report*, 11–12: 737.
1929. *Prolinognathus caviae-capensis* (Pallas), Ewing, *Manual of External Parasites*, p. 201.

PREVIOUS RECORDS. Recorded by Pallas and Cummings from *Procavia capensis* and by Bedford from *P. coombsi* and *P. natalensis*, South Africa.

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SPECIMENS EXAMINED. The material examined by Cummings, including five females, a male, and dissections of another male; a male and a female from *Procavia coombsi,* Onderstepoort, Pretoria, South Africa, received through the kindness of G. A. H. Bedford.

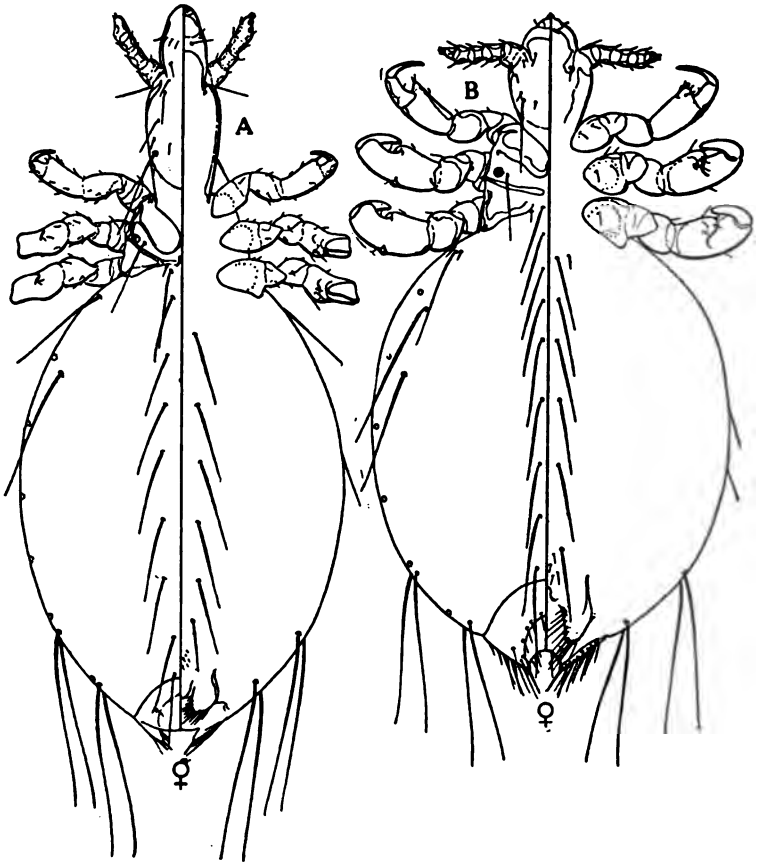

FIG. 250.—Female: *A, Prolinognathus caviae-capensis* (Cummings), from type; *B, Prolinognathus leptocephalus* (Ehrenberg), from specimen from *Procavia brucei.*

FEMALE (Fig. 250 *A*). Length 2.25 mm. *Head* (Fig. 251 *A*) about three and a half times as long as its greatest width, with well-defined sclerotic markings in the form of a dorsal band across the occipital region, a longitudinal band along the lateral margin of the hind head, and a lateral band on the margin of the fore head which is continued across the ventral surface; antennae (Fig. 251 *E*) set at about the anterior third, the last

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two segments closely fused and showing only their sensoria as evidence of segmentation.

Thorax (Fig. 251 *F*) with but the pleural phragmata sclerotic; sternal plate entirely lacking. *Legs* presenting no unusual features, the tarsus of the middle and posterior pairs with a small spur at the base.

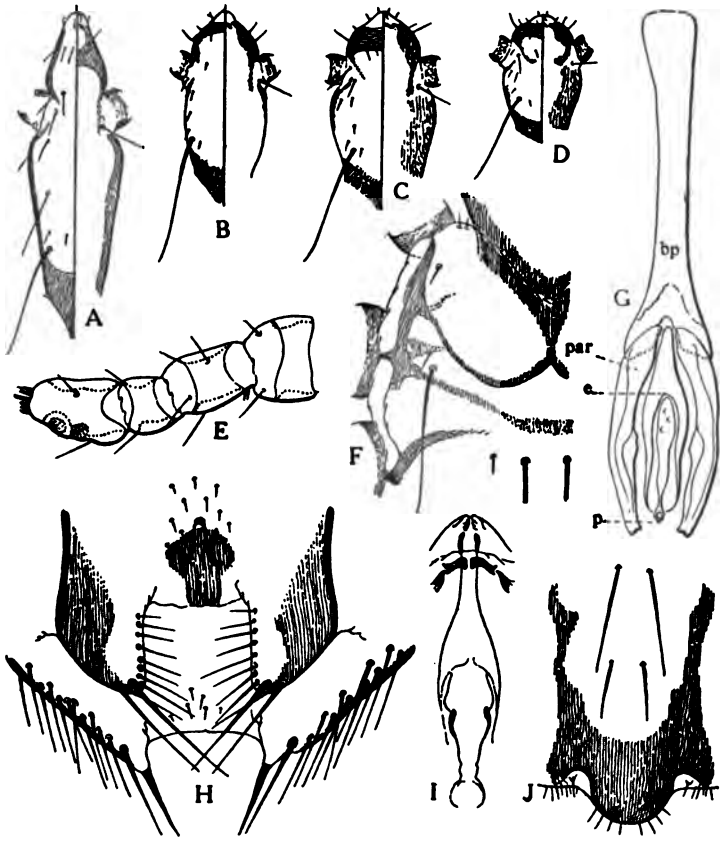

FIG. 251.—*Prolinognathus caviae-capensis* (Cummings): *A*, head of female; *E*, antenna; *F*, dorsum of thorax; *G*, genitalia of male; *H*, genital region of female; *I*, pharyngeal framework; *J*, genital plate of male; *P. leptocephalus* (Ehrenberg): *B*, *C*, *D*, heads of females.

Abdomen with but two setae in each row, both dorsally and ventrally, the second and third segments each with a single long spiracular seta and the seventh and eighth with the usual pairs of long marginal setae. Gonopophyses (Fig. 251 *H*) broad and prominent, with setae at the apex and along the mesal margin; genital plate very small; apical lobes of the ninth segment moderately prominent, beset with a row of setae and terminating in a stout spine.

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MALE. Practically identical in form with the female except for the normal sexual differences and for having the head slightly shorter and broader. *Genitalia* (Fig. 251 *G*) with the basal plate (*bp*) long and slender, the parameres (*par*) simple, the endomeres forming a long, inverted Y, the penis (*p*) at the apex of a small sclerotic rod, the pseudopenis lacking. Genital plate (Fig. 251 *J*) somewhat lyriform.

NOTES.—The writer has not seen the original description of this species, but according to Cummings the species was not actually named by Pallas, it being merely referred to in company with another organism as *"Pediculus et Taenia Caviae Capensis."* According to Giebel and Piaget it was referred to as *"Pediculus Hyracis capensis."* Whichever reference be correct, it is evident that, according to the International Code of Nomenclature, Pallas did not properly name the species. Authors previous to Cummings merely cited his name in the form in which he wrote it and it is evident that Cummings was the first to establish the name in proper binomial form. It should, therefore, be credited to him rather than to Pallas, and the specimens used by Cummings will stand as the type of the species.

It would be useless to go back of Cummings to determine the exact application of Pallas' description.

2. Prolinognathus leptocephalus (Ehrenberg)

FIGS. 250 *B*; 251 *B, C, D*

1828. *Pediculus leptocephalus* Ehrenberg, *Symbolae Physicae,* Decas Prima, p. f.
1874. *Haematopinus leptocephalus* (Ehrenberg), Giebel, *Insecta Episoa,* p. 47. (Part.)
1880. *Haematopinus leptocephalus* (Ehrenberg), Piaget, *Les Pediculines,* p. 656. (Part.)
1904. *Haematopinus leptocephalus* (Ehrenberg), Enderlein, *Zoologischer Anzeiger,* 28: 141. (Part.)
1908. *Haematopinus leptocephalus* (Ehrenberg), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 11.
1913. *Linognathus leptocephalus* (Ehrenberg), Cummings, *Bulletin of Entomological Research,* 4: 37.
1916. *Linognathus leptocephalus* (Ehrenberg), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences,* (4), 6: 162.

PREVIOUS RECORDS. Known only from the original record by Ehrenberg, from *Procavia* (= *Hyrax*) *syriacus,* presumably from Syria.

SPECIMENS EXAMINED. A single individual apparently in the penultimate instar from *Procavia syriacus,* Mount Lebanon, Syria (U.S.N.M. 13005); a female from *Procavia capensis,* Rooi Krans, Transvaal, and two females and a male from *Procavia waterbugensis,* South West Africa (all from G. A. H. Bedford); a female from *Procavia brucei rudolfi,* Marsabit Road, British East Africa (U.S.N.M. 184247).

FEMALE (Fig. 250 *B*). Length 1.5 to 2.25 mm. In every respect except the form of the head essentially the same as *P. caviae-capensis.*

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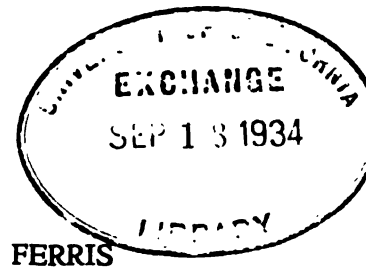
Contributions Toward a Monograph of the Sucking Lice

PART VI



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Contributions Toward a Monograph of the Sucking Lice

PART VI

By

GORDON FLOYD FERRIS

Associate Professor of Zoölogy

STANFORD UNIVERSITY PRESS
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SYSTEMATIC TREATMENT (Cont.)

Genus **HAEMATOPINUS** Leach

1815. Leach, *Encyclopaedia Britannica*, Supplement 1, p. 24.
1817. Leach, *The Zoölogical Miscellany*, 3: 64.
1835. Burmeister, *Handbuch der Entomologie*, 2: 58.
1842. Denny, *Monographia Anoplurorum Britanniae*, p. 24.
1844. Gervais, in Walckenaer, *Histoire naturelle des insectes aptères*, 3: 301.
1874. Giebel, *Insecta Epizoa*, p. 33.
1880. Piaget, *Les Pediculines*, p. 633.
1904. Enderlein, *Zoologischer Anzeiger*, 28: 138.
1908. Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 10.
1909. Neumann, *Archives de Parasitologie*, 13: 529.
1913. Patton and Cragg, *Textbook of Medical Entomology*, p. 547.
1915. Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals*, Stanford University Publications, University Series, No. 20, p. 9.
1916. Ferris, "A Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences* (4), 6: 142.
1929. Ewing, *Manual of External Parasites*, p. 137.

Anoplura without eyes; with five-segmented antennae which are not sexually dimorphic; with the legs all similar in size and form, with a stout claw and a pad-like sclerite arising from the tibia in the palm of the claw; thorax with the notum reduced to a furrow and a median pit, the sternal plate normally present but without free margins, the dorsum with a free lobe at each posterior angle; paratergal plates of the abdomen present on at least the second to eighth segments but with their margins not free from the body wall; dorsum of the abdomen characteristically more or less sclerotic and marked with irregular furrows and small plates, with the setae inconspicuous and usually somewhat peg-like in form; head with the post-antennal angles acute and directed anteriorly; occiput usually very slightly constricted into a neck, the posterior margin of the head dorsally with a pair of conspicuous internal apophyses; pleural apophysis of the prothorax conspicuous, continuous with the sternal apophysis and sometimes opening into the sternal plate; gonopophyses of the female conspicuous and the abdomen terminating in a pair of small lobes which do not bear a stout spine or seta; genitalia of the male of a characteristic type, the parameres apparently lacking, their place taken by the enlarged pseudopenis, the arms of which articulate with the basal plate and are attached also to the preputial sac, which may assume various forms.

Hosts. Occurring only on certain families of the two orders, Perissodactyla and Artiodactyla, of "ungulates," these families being the Equidae of the former and the Suidae, Camelidae, Bovidae, and Cervidae of the latter.

Type of the Genus. *Pediculus suis* Linnaeus.

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Synonymical List of Names Previously Used in the Genus

Note.—Names in italics are synonyms of the names with which they are coupled.

acanthopus (Burmeister).
Hoplopleura acanthopus (Burmeister).
acanthopus var. *affinis* (Burmeister).
Hoplopleura affinis (Burmeister).
aculeatus Neumann.
Eulinognathus aculeatus (Neumann).
albidus Rudow.
Pedicinus albidus (Rudow).
angulatus Piaget.
Linognathus angulatus (Piaget).
annulatus Schilling.
Echinophthirius horridus (Olfers).
antennatus Piaget.
Linognathus tibialis (Piaget).
antennatus Osborn.
Neohaematopinus sciurinus (Mjöberg).
appendiculatus Piaget.
Linognathus tibialis (Piaget).
asini (Linnaeus).
Haematopinus asini var. *coloratus* Piaget.
Haematopinus elegans Fahrenholz.
Haematopinus equi Simmonds.
Haematopinus macrocephalus (Burmeister).
Haematopinus minor Fahrenholz.
Pediculus asini Linnaeus.
Pediculus macrocephalus Burmeister.
aulacodi Neumann.
Scipio aulacodi (Neumann).
bicolor Lucas.
Linognathus setosus (Olfers).
bidentatus Neumann.
Hoplopleura bidentata (Neumann).
breviceps Piaget.
Linognathus breviceps (Piaget).
brevicornis Giebel.
Linognathus brevicornis (Giebel).
bufali (De Geer).
Haematopinus neumanni Fahrenholz.
Haematopinus phthiriopsis (Gervais).
Pediculus bufali De Geer.
Pediculus bufali-capensis Fabricius.
Pediculus phthiriopsis Gervais.
bufali (De Geer) (misidentification).
Haematopinus tuberculatus (Burmeister).
bufali-capensis (Fabricius).
bufali (De Geer).

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bufali-europaei (Latreille).
Haematopinus tuberculatus (Burmeister).
bufali-europaei var. *penicillatus* Piaget.
Haematopinus suis (Linnaeus).
bufali var. *punctatus* Rudow.
Haematopinus tuberculatus (Burmeister).
callorhini Osborn.
Antarctophthirus callorhini (Osborn).
cameli (Linnaeus) (part).
Microthoracius cameli (Linnaeus).
cameli (Linnaeus) (misidentification).
Haematopinus tuberculatus (Burmeister).
cervicaprae Lucas.
Linognathus cervicaprae (Lucas).
chinensis Fahrenholz.
Haematopinus suis (Linnaeus).
clavicornis (Nitzsch).
Polyplax (?) clavicornis (Nitzsch).
coloratus Piaget.
Haematopinus asini (Linnaeus).
columbianus Osborn.
Neohaematopinus columbianus (Osborn).
crassicornis (Nitzsch).
Solenopotes burmeisteri Fahrenholz.
echinatus Neumann.
Neohaematopinus echinatus (Neumann).
elegans Fahrenholz.
Haematopinus asini (Linnaeus).
equi Simmonds.
Haematopinus asini (Linnaeus).
erraticus Osborn.
Hoplopleura erratica (Osborn).
eurysternus (Nitzsch).
Haematopinus parviprocursus Fahrenholz.
Haematopinus quadripertusus Fahrenholz.
Pediculus eurysternus Nitzsch.
forficulus Rudow.
Linognathus stenopsis (Burmeister).
germanicus Fahrenholz.
Haematopinus suis (Linnaeus).
germanus Fahrenholz.
Misprint for *germanicus*.
hesperomydis Osborn.
Hoplopleura hesperomydis (Osborn).
hispidus (Grube).
Hoplopleura hispida (Grube).
incisus Harms.
Haematopinus latus Neumann.
irritans Law.
Haematopinus suis (Linnaeus).

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laeviusculus (Grube).
Neohaematopinus laeviusculus (Grube).
latus Neumann.
Haematopinus incisus Harms.
Haematopinus peristictus Kellogg and Paine (in part).
leptocephalus (Ehrenberg).
Prolinognathus leptocephalus (Ehrenberg).
leucophaeus Giebel.
Schizophthirus leucophaeus (Giebel).
longulus Neumann.
Hoplopleura longula (Neumann).
longus Neumann.
lyriocephalus (Burmeister).
Haemodipsus lyriocephalus (Burmeister).
macrocephalus (Burmeister).
Haematopinus asini (Linnaeus).
macrocephalus var. *coloratus* Piaget.
Haematopinus asini (Linnaeus).
maniculatus Neumann.
Hoplopleura maniculata (Neumann).
microcephalus Garnett.
Linognathus pedalis (Osborn).
minor Fahrenholz.
Haematopinus asini (Linnaeus).
montanus Osborn.
Neohaematopinus laeviusculus (Grube).
muris Compton.
Polyplax or Hoplopleura sp.
neumanni Fahrenholz.
Haematopinus bufali De Geer.
notophallus Neumann.
Hybophthirus notophallus (Neumann).
obtusus Rudow.
Pedicinus obtusus (Rudow).
oviformis Rudow.
Linognathus oviformis (Rudow).
ovillus Neumann.
Linognathus ovillus (Neumann).
ovis Lugger.
Linognathus pedalis (Osborn).
parviprocursus Fahrenholz.
Haematopinus eurysternus (Nitzsch).
pectinifer Neumann.
Neohaematopinus pectinifer (Neumann).
pedalis Osborn.
Linognathus pedalis (Osborn).
penicillatus Piaget.
Haematopinus suis (Linnaeus).
peristictus Kellogg and Paine.
Haematopinus latus (Neumann) (in part).

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Haematopinus phacochoeri Enderlein (in part).

phachochoeri Enderlein.

Misspelling for phacochoeri.

phacochoeri Enderlein.

Haematopinus peristictus Kellogg and Paine.

Haematopinus phachochoeri Enderlein (misprint).

phacochoeri Enderlein (misidentification).

Haematopinus latus Neumann.

phthiriopsis (Gervais).

Haematopinus bufali (De Geer).

piliferus (Burmeister).

Linognathus setosus (Olfers).

praecisus Neumann.

Hoplopleura neumanni Fahrenholz (in part).

Polyplax praecisa (Neumann) (in part).

praelongiceps Neumann.

Microthoracius praelongiceps (Neumann).

punctatus Rudow.

Haematopinus tuberculatus (Burmeister).

quadridentatus Neumann.

Hoplopleura quadridentata (Neumann).

quadripertusus Fahrenholz.

Haematopinus eurysternus (Nitzsch).

quadrumanus Murray.

Pediculus sp.

reclinatus (Nitzsch).

Polyplax reclinata (Nitzsch).

rupicaprae Rudow.

Linognathus stenopsis (Burmeister).

saccatus (Gervais).

Linognathus saccatus (Gervais).

sardiniensis Fahrenholz.

Haematopinus suis (Linnaeus).

sciuropteri Osborn.

Neohaematopinus sciuropteri (Osborn).

serratus (Burmeister).

Polyplax serrata (Burmeister).

setosus Lucas.

Echinophthirius horridus (Olfers).

setosus Piaget.

Neohaematopinus pectinifer (Neumann).

sphaerocephalus (Nitzsch).

Enderleinellus nitzschi Fahrenholz.

sphaerocephalus (Nitzsch) (misidentification).

Neohaematopinus sciurinus (Mjöberg).

spiculifer (Gervais).

An unrecognizable species of *Polyplax* or *Hoplopleura*.

spiniger (Burmeister).

Polyplax spiniger (Burmeister).

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spinulosus (Burmeister).
Polyplax spinulosa (Burmeister).
squamulatus Neumann.
Ratemia squamulata (Neumann).
stenopsis (Burmeister).
Linognathus stenopsis (Burmeister).
stephensi Christophers and Newstead.
Polyplax stephensi (Christophers and Newstead).
suis (Linnaeus).
Haematopinus irritans Law.
Haematopinus suis var. *adventicius* Neumann.
Haematopinus suis var. *chinensis* Fahrenholz.
Haematopinus suis var. *germanicus* Fahrenholz.
Haematopinus suis var. *sardiniensis* Fahrenholz.
Haematopinus urius (Nitzsch).
Pediculus suis Linnaeus.
Pediculus urius Nitzsch.
suis (Linnaeus) (part; misidentification).
Haematopinus aperis n. sp.
suis var. *suis* (Linnaeus) (part; misidentification).
Haematopinus aperis n. sp.
suturalis Osborn.
Enderleinellus suturalis (Osborn).
taurotragi Cummings.
tenuirostris Giebel.
Linognathus vituli (Linnaeus).
tibialis Piaget.
Linognathus tibialis (Piaget).
tibialis var. *antennatus* Piaget.
Linognathus tibialis (Piaget).
tibialis var. *appendiculatus* Piaget.
Linognathus tibialis (Piaget).
tibialis var. *cervicaprae* Lucas.
Linognathus cervicaprae (Lucas).
trichechi Bohemann.
Antarctophthirus trichechi (Bohemann).
tuberculatus (Burmeister).
Haematopinus bufali (De Geer) (misidentification).
Haematopinus bufali-europaei (Latreille).
Haematopinus bufali var. *punctatus* (Rudow).
Haematopinus tuberculatus var. *punctatus* Rudow.
Pediculus tuberculatus Burmeister.
tuberculatus var. *penicillatus* Piaget.
Haematopinus suis (Linnaeus).
tumidus Schilling.
Echinophthirius horridus (Olfers).
ungulatus Piaget (misprint).
Linognathus angulatus (Piaget).
urius (Nitzsch).
Haematopinus suis (Linnaeus).

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ventricosus Denny.

Haemodipsus ventricosus (Denny).

vituli (Linnaeus).

Linognathus vituli (Linnaeus).

NOTES.—The genus *Haematopinus* was interpreted for nearly a hundred years (1810–1904) as including by far the greater part of all the species of the sucking lice, and consequently nearly a hundred names have been used in it. It was first broken up by Enderlein (1904), who separated off a number of genera and restricted *Haematopinus* to the limits which are now accepted. As late as 1909, however, Neumann protested against this procedure and placed the genera of Enderlein merely as subgenera. He has been followed in this by even later authors in various textbooks of parasitology.

There can now be no question as to the correctness of Enderlein's action. The genus as restricted by him undoubtedly represents a natural group of closely related forms. They are all species of large size, with their strongly developed claws and legs adapted for clinging to coarse hair and their tough and relatively sclerotic derm apparently adapted in high degree to a greater amount of exposure upon their sometimes thinly haired hosts than is the case with the majority of the species of the order. In the genus as now restricted between twenty-five and thirty specific and subspecific names have been used. These are reduced in the present treatment to ten species, of which one is here named as new. It is probable that at least half, if not more, of the species actually existing are now known.

The genus is exceedingly well defined, and there are no others that can easily be confused with it. It is particularly important from the point of view of comparative morphology, but all discussion of such matters will be relegated to a later portion of these papers. For the present there are presented merely data sufficient to make generic identification definite.

1. Haematopinus suis (Linnaeus)

FIGS. 252 *A*; 253 *A*; 254; 255 *E–X*; 256

NOTE.—The bibliography of this species is extremely extensive. However, comparatively few of the references are of any value from the point of view of systematics. An attempt is here made to select those which are of significance in following the nomenclatorial history of the species, in establishing distributional records, or in contributing something to the knowledge of morphology or systematics. Consequently the references in most of the textbooks of parasitology or in the bulletins of agricultural bureaus and departments are omitted. These can be found, if desired, in the reference by Stevenson cited below.

1634. *Pediculus urius* Mouffet, *Insectorum sive minimorum animalium theatrum*, p. 266.

1758. *Pediculus suis* Linnaeus, *Systema Naturae* (ed. 10), p. 611.

1761. *Pediculus suis* Linnaeus, Linnaeus, *Fauna Suecica*, p. 476.

1793. *Pediculus suis* Linnaeus, Panzer, *Faunae insectorum germanicae initia*, pl. 16.

1805. *Pediculus suis* Linnaeus, Fabricius, *Systema Antliatorum*, p. 342.

1810. *Haematopinus suis* (Linnaeus), Leach, *Encyclopaedia Britannica, Supplement*, 1, p. 24.

1815. *Haematopinus suis* (Linnaeus), Leach, *Edinburgh Encyclopedia*, 9:77.

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1817. *Haematopinus suis* (Linnaeus), Leach, *Zoölogical Miscellany*, 3: 65; pl. 46.
1818. *Pediculus urius* Nitzsch, *Germar's Magazin der Entomologie*, 3: 305.
1835. *Haematopinus suis* (Linnaeus), Burmeister, *Handbuch der Entomologie*, 2: 58.
1838. *Pediculus suis* Linnaeus, Burmeister, *Genera Insectorum, Rhynchota, Species 19.*
1842. *Haematopinus suis* (Linnaeus), Denny, *Monographia Anoplurorum Britanniae*, p. 34; pl. 25, fig. 2.
1844. *Hoematopinus* [*sic*] (*Pediculus*) *suis* Linnaeus, Gervais, in Walckenaer, *Histoire naturelle des insectes aptères*, 3: 301.
1874. *Haematopinus urius* (Nitzsch), Giebel, *Insecta Epizoa*, pp. 45–46; pl. 2, fig. 6.
1880. *Haematopinus urius* (Nitzsch), Piaget, *Les Pediculines*, pp. 654–656; pl. 48, fig. 4.
1885. *Haematopinus tuberculatus* var. *penicillatus* Piaget, *ibid.*, Supplement, p. 146; pl. 15, fig. 9.
1891. *Haematopinus urius* (Nitzsch), Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (old series), 7: 18–21; fig. 8.
1896. *Haematopinus urius* (Nitzsch), Osborn, *ibid., Bulletin* (new series), 5: 178–180; fig. 102.
1903. *Haematopinus irritans* Law, *Textbook of Veterinary Medicine*, 5: 13.
1904. *Haematopinus suis* (Linnaeus), Enderlein, *Zoologischer Anzeiger*, 28: 124.
1905. *Haematopinus suis* (Linnaeus), Stevenson, *United States Department of Agriculture, Bureau of Animal Industry, Bulletin*, 69: 9–16; figs. 1–17.
1908. *Haematopinus suis* (Linnaeus), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 11; fig. 4.
1911. *Haematopinus suis* (Linnaeus), Neumann, *Archives de Parasitologie*, 14: 406; fig. 8 (part).
1911. *Haematopinus suis* var. *adventicius* Neumann, *ibid.*, 14: 406; fig. 8.
1913. *Haematopinus suis* var. *adventicus* Neumann, Patton and Cragg, *Textbook of Medical Entomology*, p. 548; pl. 68, fig. 3. (Misprint for *adventicius*.)
1916. *Haematopinus suis* var. *chinensis* Fahrenholz, *Zoologischer Anzeiger*, 48: 90.
1916. *Haematopinus suis* var. *germanus* Fahrenholz, *ibid.*, 48: 90. (Misprint for *germanicus*.)
1917. *Haematopinus suis* var. *adventicius* Neumann, Fahrenholz, *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 34, Beiheft 2: 10.
1917. *Haematopinus suis* var. *sardiniensis* Fahrenholz, *ibid.*, 34, Beiheft 2: 10.
1917. *Haematopinus suis* var. *chinensis* Fahrenholz, Fahrenholz, *ibid.*, 34, Beiheft 2: 10; fig. 2*a*.
1917. *Haematopinus suis* var. *germanicus* Fahrenholz, Fahrenholz, *ibid.*, 34, Beiheft 2: 11; fig. 2*b*.
1921. *Haematopinus suis* (Linnaeus), Florence, *Cornell University Agricultural Experiment Station Memoir*, 51: 641–725; pls. 58–66.
1924. *Haematopinus suis* (Linnaeus), Freund, *Prager Tierärztlicher Archiv*, 4(A): 53; fig. 7.
1927. *Haematopinus suis* (Linnaeus), Freund, *Prager Archiv für Tiermedizin*, 7(A): 44; fig. 4.
1928. *Haematopinus suis* var. *adventicius* Neumann, Buxton, *Insects of Samoa*, 7: 3: 85.

PREVIOUS RECORDS. From domestic pigs in all parts of the world. From wild pigs in Asia, including *Sus jubatus*, Pahang, Malaysia, and *Sus*

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vittatus, without indication of locality. Records of the species from *Sus scrofa,* the wild boar of Europe, are here regarded as erroneous.

MATERIAL EXAMINED. Owing to the large amount of material which has been available for examination it will be advisable to divide the records into three sections, one including those of specimens from domesticated or presumably domesticated hosts, one including those from wild or presumably wild hosts, and one for abnormal records.

1. FROM DOMESTIC, PRESUMABLY DOMESTIC, OR FERAL SWINE

EUROPE

Germany: vicinity of Hamburg Neugraben, 12:6:1929, *F. Diehl;* Holte bei Cuxhaven, 20:7:1929; Tübingen, 26:vii:1912, *W. Nöller;* Thüringen, 1919, *W. Nöller.* All the foregoing in the Hamburg Museum collection. Switzerland: Kröschenbrunnen, Bern (Molteno Institute). France (?): from the Neumann Collection, "sur *Sus scrofa domestica* Railliet Alfort Juin 98," and "1/3/87." England: Cambridge, *John Clay,* being part of the material included by Neumann in his description of *H. suis adventicius,* together with other lots from the same locality (Molteno Institute); Holmes Chapel, Cheshire (British Museum).

AFRICA

Ilesha, Lagos, *Leishman* (Molteno Institute); Kabete, Kenya Colony (British Museum).

NORTH AND SOUTH AMERICA

California (Stanford University). Mexico: Coyoacan, *Zelia Nuttall,* being part of the material included by Neumann in the original description of his *H. suis adventicius* (Molteno Institute); Mexico City, *Valadez* (Stanford University). Colombia: Bogota and Barranquilla, *L. H. Dunn* (Stanford University). British Guiana: Georgetown, *Cleake* and *Bodkin* (British Museum).

AUSTRALIA

Queensland, *W. A. T. Sommerville* (British Museum).

ASIA

China: the types and other specimens from the type lot of *H. suis chinensis* Fahrenholz, Fokien Province, *Siemssen* (Hamburg Museum); Kwei Chou Fou and Kaihsien, Szchuen, *S. A. Stericker* (Molteno Institute); Shanghai, *Dr. A. Stanley* (Molteno Institute); Weihaiwei, *Dr. W. M. Muat* (British Museum). India: Larpur, Bengal (Indian Museum). Burma: Rangoon, *Dr. H. H. Marshall* (Molteno Institute). Cey-

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lon: Hakgala, *H. H. N. Pearson* (Molteno Institute). Malay Peninsula: Bukit Mertajan, *Prof. Wellesley* (British Museum). Philippine Islands: Los Baños, *Woodworth* (Stanford University).

South Sea Islands

Fiji: Tavenni, *T. P. Jepson* (Molteno Institute). New Hebrides: Hog Harbor, *Buxton* and *Hopkins* (British Museum). Samoa: Upol "from pigs recently imported from New Zealand," *Buxton* and *Hopkins*. Tahiti: two slides from the Neumann collection labeled, "*H. suis adventicius* Taiti I 05 M. Seural Dr. Trouessart VI–06."

2. From Wild or Presumably Wild Species

From *Sus cristata,* Tanjong Badak, Tenasserim, a single female from a skin in the United States National Museum and a male and female, Bihar, Dinapore, 16: 12 : 4 (British Museum). From "wild pigs," perhaps a wild species, Penang, Federated Malay States, *Dr. A. T. Stanton* (Molteno Institute).

3. Abnormal Records

A single slide from the Piaget Collection (British Museum), labeled as *Haematopinus tuberculatus* var. *penicillatus* Piaget, "sur un *Bos indicus* (zebu.)" A male and female labeled as from "Buffalo, Dinipur Sarar, Bihar," in the British Museum.

A slide from the British Museum labeled simply "the camel."

Female (Fig. 252 *A*). One of the largest of the Anoplura, reaching a maximum observed length of nearly 6 mm., but varying down to an observed minimum (in slide preparation) of 4.5 mm. Typically strongly pigmented and sclerotic. *Head* (Fig. 254) elongate, being from two to three times as long as wide, the fore head and hind head approximately equal in length. *Thorax* quite strongly trapezoidal in form, with the lateral margins convex, normally with its greatest width about equal to the length of the head and with its length considerably shorter; posterior lateral angles with a strongly developed dorsal lobe. *Legs* very large and strong. Sternal plate somewhat variable in form (Fig. 255), the openings of the sternal apophyses included within its limits.

Abdomen broadly ovate, usually strongly pigmented, the more or less quadrate paratergites appearing as a black marginal band, the margins usually quite strongly lobed by intersegmental constrictions, the constriction between the sixth and seventh segments being especially marked.

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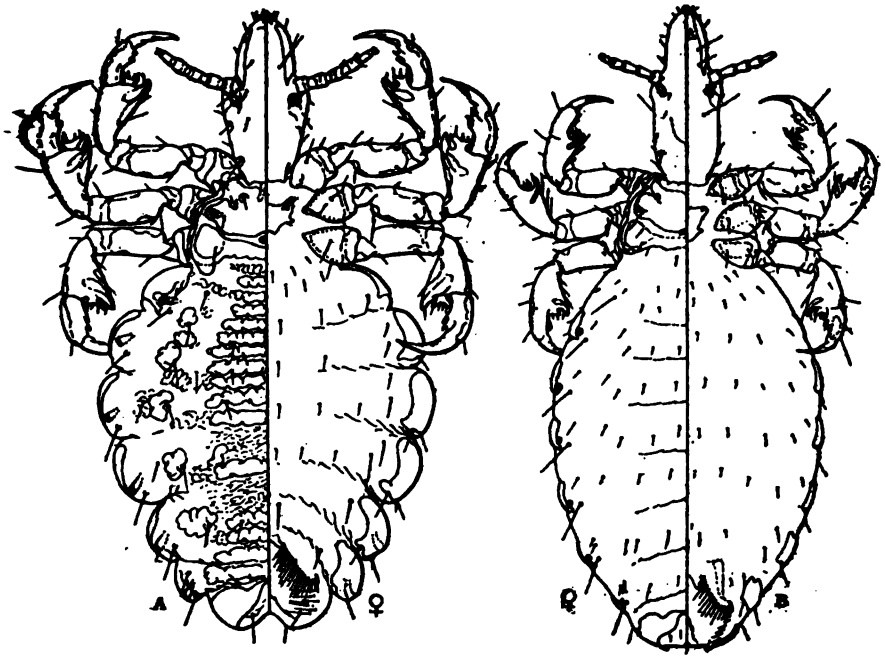

FIG. 252.—Females: *A, Haematopinus suis* (Linnaeus); *B, Haematopinus aperis* n. sp.

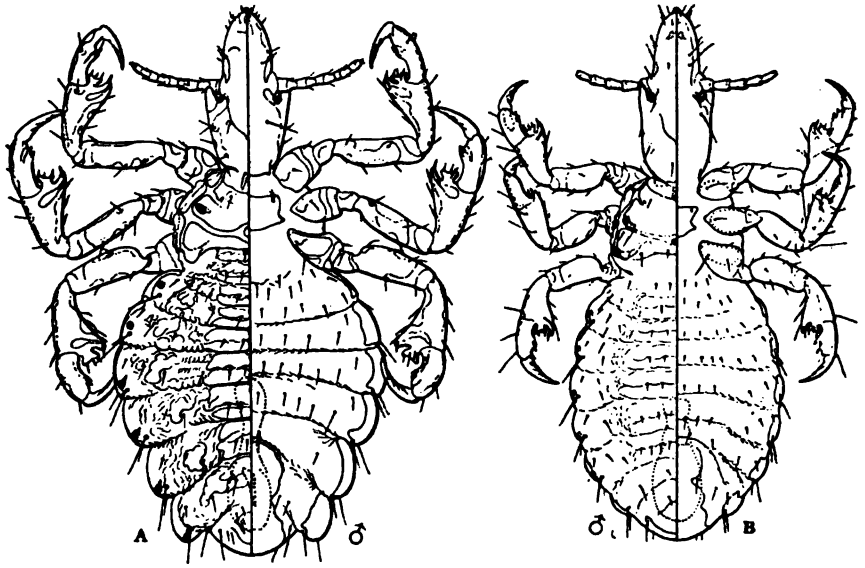

FIG. 253.—Males: *A, Haematopinus suis* (Linnaeus); *B, Haematopinus aperis* n. sp.

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Tergites typically quite strongly sclerotic, with small, irregular, submarginal plates and with three pairs of median plates, separated by a slight median line, on the third (first apparent) to fifth segments, there

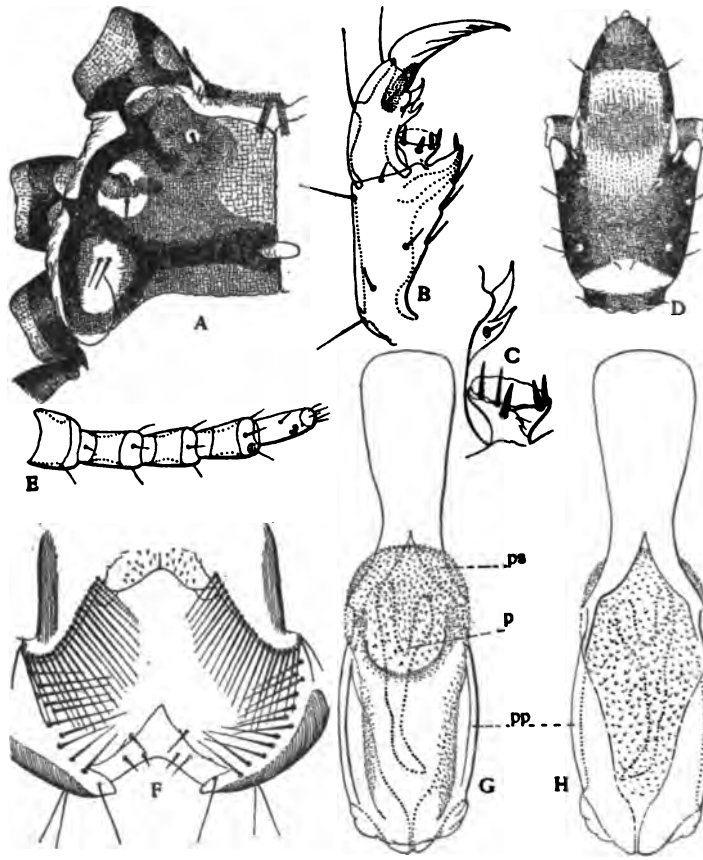

FIG. 254.—*Haematopinus suis* (Linnaeus): *A*, dorsum of thorax; *B*, anterior tibio-tarsus; *C*, pretarsal sclerite detail of tibio-tarsus; *D*, dorsal aspect of head; *E*, antenna of female; *F*, genital region of female; *G*, *H*, genitalia of male.

being then a characteristic break, the sixth segment having but one plate and the seventh and eighth two. Ventral side entirely membranous. Gonopophyses (Fig. 254 *F*) elongate; vulva emarginate and simple.

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MALE (Fig. 253 *A*). Length ranging from 3.5 to 4.75 mm. In general characteristics of head and thorax closely resembling the female. *Abdomen* more rounded, with the margins somewhat less deeply lobed, and with but two pairs of median tergal plates on each segment. Genital plate small, but conspicuous. *Genitalia* (Fig. 254 *G, H*) of a type rather distinct from the other members of the genus, the pseudopenis forming a broad, apically truncate piece which supports the entirely membranous preputial sac into the folds of which is withdrawn the slender, funnel-shaped penis.

NOTE.—The discussion of this species will follow the description of the next.

2. Haematopinus aperis n. sp.

FIGS. 252 *B*; 253 *B*; 255 *A–D*; 256 *F, G, M, N*

1880. *Haematopinus urius* (Nitzsch), Piaget, *Les Pediculines*, pp. 654–656; pl. 48, fig. 4 (the plate and the description in part).
1911. *Haematopinus suis suis* (Linnaeus), Neumann, *Archives de Parasitologie*, **14**: 406–408 (in part).
1917. *Haematopinus suis suis* (Linnaeus), Fahrenholz, *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, **34**, Beiheft 2: 9.

PREVIOUS RECORDS. Recorded by Piaget, Neumann, and Fahrenholz from *Sus scrofa*, the wild boar of Europe.

MATERIAL EXAMINED. Two males and two females from the Piaget Collection, from *Sus scrofa*, now in the British Museum. These include the holotype and allotype. Two males and one female from the same host, central Hungary, in the British Museum. Two males in the Neumann Collection, now at the École Veterinaire de Toulouse, labeled "du Sanglier M. Chevalier 1896."

FEMALE (Fig. 252 *B*). Length, on slide, 5.5 mm. Differing from the preceding species by its pale coloring, its conspicuously more slender form, the relatively more slender head, which has a length of nearly three times its width, the relatively small legs, the extremely small paratergites, which are reduced to widely separated areas, the form of the sternal plate which is typically (Fig. 255 *A–D*) about as long as wide and rather acute posteriorly, and by the absence or great reduction of the lateral lobes of the abdomen.

MALE (Fig. 253 *B*). Length 4.00 to 4.25 mm. Differing from *H. suis* as does the female. Tergal plates of the abdomen at the most but faintly indicated. Genitalia as in *H. suis*.

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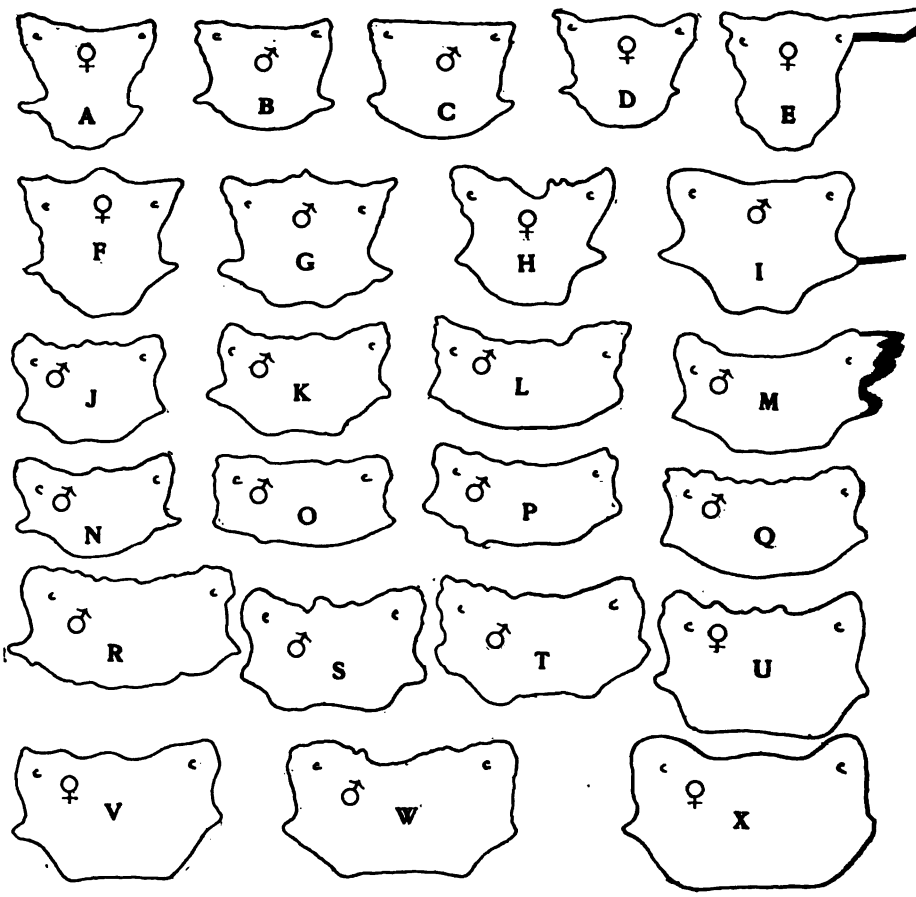

FIG. 255.—Thoracic sternal plates of *Haematopinus aperis* n. sp.: *A*, *B*, from specimens from the Piaget Collection; *C*, *D*, from Hungary. *Haematopinus suis* (Linnaeus) from domestic swine: *E*, *F*, *G*, from specimens from Switzerland; *H*, *I*, *J*, *K*, *L*, from China; *M*, Penang; *N*, Mexico; *O*, Ceylon; *P*, California; *Q*, Mexico; *R*, England; *S*, China; *T*, Philippine Islands; *U*, China; *W*, *X*, Germany; *V*, specimen from *Sus cristata*.

THE LICE OF SWINE

Previous to 1911 authors dealing with the lice of either domestic or wild swine placed the parasites without hesitation under the name *Haematopinus suis* (Linnaeus). Neumann, in that year, was the first to recognize the fact that differences of very considerable degree can be detected among lice from different sources. He therefore divided *Haematopinus suis* into two forms or subspecies, the name *H. suis suis* being retained for the lice

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of the wild boar, including that of Sardinia, and the lice of domestic pigs of continental Europe. The name *H. suis adventicius* was proposed for the lice of domestic pigs of other parts of the world and of wild pigs of Asia, including the species *Sus vittatus* and *Sus jubatus*. No type was designated. His record indicates that he had at hand specimens from China, Africa, Mauritius, Australia, England, Tahiti, and Mexico. He assumed that *H. suis adventicius* had originated from the wild pigs of Asia.

Fahrenholz (1916, 1917) carried the process of division still farther. He restricted the name *H. suis suis* to specimens from the wild boar of Europe, *Sus scrofa*, and proposed three more subspecific names, *H. suis sardiniensis* for the louse of the wild pig of Sardinia, *H. suis chinensis* for lice from pigs in China which he assumed to represent the supposed form *Sus leucomystax continentalis*, and *H. suis germanicus* for the lice from some domestic pigs in Germany.

We thus have a total of five supposed subspecies, the status of which is a subject for inquiry. There are two problems involved. One has to do merely with nomenclature. The other is that of the biological facts. It may be well to dispose of the nomenclatorial problem first.

Nomenclature.—It will be noted that the result of the process of division has been to transfer the name *suis* from the lice of domestic swine, for which it has commonly been used, to the lice of the wild boar of Europe. The result cannot but be disturbing to parasitologists, for whose purposes stability of nomenclature is highly desirable, since a very good case can be made out for the recognition of the louse of the wild boar of Europe as a distinct species. Such is the procedure followed by the present writer, and if it be accepted by other workers the name *suis* must be replaced by some other for the lice of domesticated swine. Cannot this change be avoided? It is the opinion here maintained that it can, it having resulted from the failure of Neumann and Fahrenholz to investigate the facts and follow the commonly accepted rules of nomenclature.

The nomenclatorial history of *Haematopinus suis* begins with the tenth edition of the *Systema Naturae* (1758). Here, on page 611, we find merely the following under the genus *Pediculus:*

Suis 5. P. Suis Scrofae.
Habitat in Suibus β.

The symbol *β* refers unquestionably to a heading under the description of *Sus scrofa*, where we find the following:

Scrofa. 1. S. dorso antice setoso, cauda pilosa. *Fn. suec.* 36. *Syst. nat.* 12.
Aper. *Gesn. quadr.* 146. *Aldr. bisulc.* 1013. *Jonst. quadr.* 74. *Raj. quadr.* 96.
β Sus. *Gesn. quadr.* 872. *Aldr. bisulc.* 937. *Jonst. quadr. t.* 47. *Raj. quadr.* 92.

It needs no searching of the ancient references cited to determine the facts.

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Aper is the word for wild boar, and it is because of this that the name *Sus scrofa* is applied to that animal, and not to domestic swine, by mammalogists. The use of this name for domestic swine will be found in the writings of entomologists but is entirely erroneous. The symbol β applies to the domestic form, and consequently we cannot but conclude that these are the habitat of *Pediculus suis*. It would be surprising were it otherwise. This belief is further confirmed by the *Fauna Suecica* (1761), where we find (p. 476) the following:

1942. PEDICULUS *Suis* Suis Scrofa
Habitat in *Suibus* domesticis.

And, as late as 1835, Gervais records the species merely as a parasite of the "cochon domestique."

It is evident, therefore, that the name *suis* must be retained for the lice of domestic swine and that those of the wild boar must be given another name if they are to be nomenclatorially recognized. Apparently no such name is available, and that of *H. aperis* n. sp. is here proposed for them. We are not yet, however, out of our nomenclatorial difficulties.

If the lice of domestic swine be nomenclatorially subdivided, as Fahrenholz would have it and possibly later authors will agree, we are still in doubt as to the exact application of the name *suis suis*. To which of the various forms does it belong? It would appear that the name applies to the lice of domestic swine of Sweden as represented by specimens taken in 1758, and lacking such specimens it may be applied to these lice as they may appear whenever a division of *Haematopinus suis* is attempted. If there has indeed been hybridizing and a mixing of the louse population, as has probably been the case, we have no means of knowing that the lice of today are the same as they were over a hundred years ago. Unfortunately no specimens are at hand from Sweden.

From the writer's point of view the question is not immediately important, since he declines to recognize any such division of the lice from domestic pigs. But as future workers may disagree, it may be well to sum up here the status of the various so-called subspecies and their characters as given by their authors.

HAEMATOPINUS SUIS SUIS (Linnaeus)

This name must be used for lice of the form dominant on domestic swine in Sweden. Its characters are not known.

HAEMATOPINUS SUIS ADVENTICIUS Neumann

Originally described by Neumann without indication of type. Restricted by Fahrenholz and the type designated as from *Sus vittatus* as represented by specimens in the hands of Neumann and recorded without

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indication of locality. This is a form with short and broad sternal plate, strongly pigmented and with large paratergal plates. Unfortunately the specimens from *Sus vittatus* are said by Dr. Martin not to be present in the Neumann Collection (1930).

HAEMATOPINUS SUIS SARDINIENSIS Fahrenholz

It is somewhat doubtful that this form is nomenclatorially established. Fahrenholz merely refers to the figure given by Neumann (1901) and said by him to be of *H. suis suis*. Fahrenholz states that this figure probably refers to specimens from *Sus meridionalis* (= *S. scrofa nana*) which in the form of the sternal plate agree with it. The promised description of the supposed form seems never to have appeared. It seems probable that this is the form, to be discussed later, which appears to occur only on pigs of continental Europe and is marked by large size, relatively very long head, somewhat reduced paratergal plates, and a somewhat triangular or quadrate sternal plate. This form approaches that of the wild boar but is here retained with *H. suis*.

HAEMATOPINUS SUIS CHINENSIS Fahrenholz

Based upon specimens in the Hamburg Museum, from Fokien Province, China, col. Siemssen, without indication of host but in all probability from domestic swine. It was supposed by its author to be distinguished primarily by the form of the sternal plate.

HAEMATOPINUS SUIS GERMANICUS Fahrenholz

Described from specimens from "*Sus scrofa domesticus;* englische Rasse.—Provinz Hannover.—Type in Sammlung Fahrenholz." Supposed to be distinguished by the broad and rather regular sternal plate and by its large size, the female reaching a length of as much as 5.18 mm. The value of these characters will be discussed below.

HAEMATOPINUS PENICILLATUS Piaget

From the nomenclatorial point of view this name must here be considered. *H. penicillatus* was described by Piaget as a subspecies of *H. tuberculatus,* from the zebu. The Piaget Collection, now in the British Museum, contains a single specimen bearing the original labels of Piaget but remounted by the present writer. It is a specimen of *H. suis* of the type here regarded as being probably the *H. sardiniensis* of Fahrenholz. It does not agree with the description and figure given by Piaget. It would seem that the best procedure in the future would be simply to disregard the name, although if it be used it must, on the evidence of this specimen, be for the form named by Fahrenholz *H. suis sardiniensis*.

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HAEMATOPINUS IRRITANS Law

The volume in which this name appeared is not available to the writer. It appears, however, to have been nomenclatorially established, and in strict accord with nomenclatorial rules must be considered in the course of any attempt to subdivide *H. suis*. It is in all probability quite unidentifiable.

EXAMINATION OF THE DATA

The problem presented by *Haematopinus suis* and its supposed subspecies is worthy of rather extended treatment, not only because of the fact that the species is one of the most familiar of the sucking lice, but because of the opportunity which it presents for a contribution to the methodology of the systematics of the group. It is herein definitely accepted as a principle that no final disposal of the questions here involved can be achieved merely by the examination of preserved specimens. They are questions of genetic relationships and as such should be approached by experimental methods. But no one is likely soon to assemble living specimens from the wild pigs of Europe and Asia in a laboratory where they can be reared and genetically analyzed. The best that can be done is to examine the widest range of material that it is possible to procure, to take into consideration the factor of normal variation, to allow for the existence of local strains fostered by isolation, to consider the possibilities of hybridization, and, finally, to formulate conclusions which it may be hoped will be approximately in accord with the biological facts and which will conform to the demands of a practical system of nomenclature.

It might on purely *a priori* grounds be assumed that a parasite which occurs upon animals of several distinct, even though closely related, species that range naturally from western Europe to the farthest islands of Malaysia will present well-defined local forms of distinct and fixed genetic composition. In this particular case the matter is complicated by the facts that the hosts have in part become domesticated, that the origin of these domestic forms is doubtful, that they have been transported indiscriminately about the world, and that they have in turn at times become feral and possibly bred back with native wild races.

Ideally it would be desirable to examine a large number of the parasites from purely wild hosts from many localities where mixing with domesticated animals probably has not occurred, if such localities exist. Such a series of parasites has not been available to any worker. Nevertheless the material at hand is reasonably extensive. Only three specimens are positively known to be from a naturally wild—not feral—species, although there are others which may possibly be so and some of the material in all probability represents fairly the louse population of the native wild pigs of the region from which it came.

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With all of these considerations in mind we may proceed to an examination of the data.

Total length.—The use of this measurement is for the most part impracticable, for it is subject to a wide range of variation correlated with the condition of the specimens. Whether the individual be full-fed or not; whether in the case of the female it be gravid; the effects of the method of preparation; to say nothing of the possible effects, still uninvestigated, of such factors as season or condition or habits of the host—all these things must be considered. The best that can be said is that a specimen is "large" or "small." The length of some hard, fixed part, such as the head, could undoubtedly be used as something of an index to total length.

A comparison of specimens at hand, all prepared in essentially the same way, gives the following results as to total length: A female and a male in the Neumann Collection (Railliet) are, respectively, 6.00 and 4.5 mm., this being the largest female, but not the largest male, seen. Both are longer than the lengths given by Fahrenholz for his *H. germanicus* (5.18 and 4.32 mm. maxima), of which he said, "wir haben es hier mit der gröszten aller bekannten Haematopini zu thun," although in other respects they do not agree with his form. Three females from Switzerland, of a type similar to the preceding specimen, show a length range of 5.75, 5.25, and 4.75 mm., and two males are 4.5 mm. each. Three females from Shanghai, China, are 4.5, 4.75, and 5.00 mm., and a male is 4.00 mm. A male from Rangoon, the smallest seen, is 3.5 mm. A female and a male from Penang, Federated Malay States, are 4.5 and 4.00 mm., respectively, these specimens having the shortest and broadest heads seen. The male and female here figured, from Los Baños, Philippine Islands, are, respectively, 4.25 and 4.75 mm. A female and a male from Fiji are 5.00 and 4.75 mm., respectively.

These data could be extended indefinitely and are merely selections from measurements made. They are sufficient to demonstrate that there is noticeable variation between specimens even from the same lot, that there is relatively little correlation between male and female, and that there are no sharp lines of demarcation.

Head length and form.—Neumann, in naming his subspecies *adventicius,* emphasized the differences in head form having to do with the relative lengths of the fore and hind head. In order to show the range of variation in length as among various specimens and differences in proportions of parts, the accompanying graphs (Figs. 256, 257) are presented. The lengths were taken with the aid of the camera lucida from the base of the rostral tubercle to the base of the occipital apophyses and the percentage of observational error is probably quite low. In the graph the notch indicates the center of the head-length, the cross line indicates the

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position of the base of the post-antennal sinus, the upper portion of the graph is the fore head, and the lower portion is the hind head.

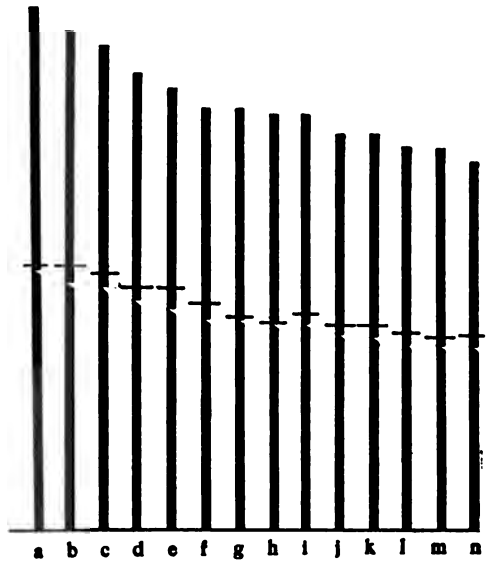

FIG. 256.—Graph to show variation of length of head and component parts of females of *Haematopinus aperis* n. sp., based upon specimens from: *b*, Piaget Collection, and *c*, Hungary; and of *Haematopinus suis* (Linnaeus) based upon specimens from: *a*, France; *b* and *d*, Switzerland; *e*, England; *f*, Lagos, Africa, and Homes Chapel, England; *g*, Kwei Chou Fu, China; *h*, Philippine Islands; *i*, Shanghai, *k*, Colombia; *l*, Mexico; *m*, specimen from *Sus cristata*, Tenasserim; *n*, from "wild pig," Federated Malay States.

It will be evident from these graphs that attempts to separate forms on total head-length alone are hopeless, the intergradation being complete between the longest and the shortest heads. Nor, it is evident, is anything to be inferred from differences in relative length of fore and hind head, the observational error alone probably being greater than those differences which actually exist.

The greatest head-lengths, however, are correlated with other characters to at least a certain extent.

The ratio of head-length to head-breadth can hardly be used with any degree of satisfaction. It is evident that the longer heads are also more narrow, but precise measurement is out of the question because of the difficulty of obtaining fixed points for determining width. In Fig. 258 *H, I, J* are shown the superposed heads of three forms, two of which

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are extremes and one intermediate. The smallest head is slightly less than twice as long as wide (1.8), while the largest is slightly more than twice as long as wide (2.03). There is nothing especially significant here, and a completely intergrading series exists.

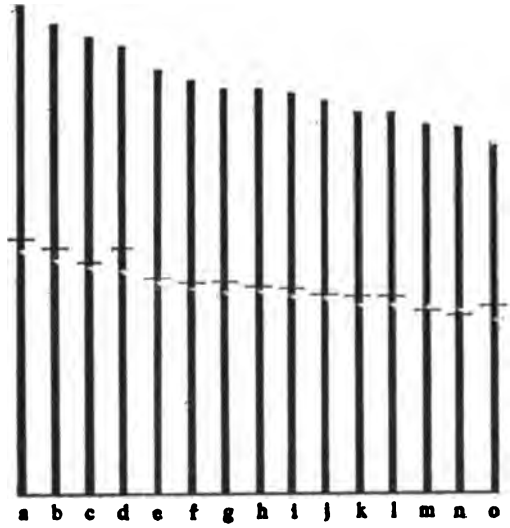

FIG. 257.—Graph to show variation of length of head and component parts of males of *Haematopinus aperis* n. sp., based upon specimens from: *c*, Piaget Collection, and *d*, Hungary; and of *Haematopinus suis* (Linnaeus) from: *a*, France; *b*, Switzerland; *e*, Ceylon; *f*, England; *g*, Kwei Chou Fu, China; *h*, Philippine Islands; *i*, England; *j*, Mexico; *k*, California; *l*, Ceylon; *m*, England; *n*, Rangoon; *o*, specimens from "wild pigs," Federated Malay States.

Relation of head-length to thoracic breadth.—The use of the relation of head-length to thoracic breadth is rendered difficult and unreliable by the high degree of observational error which is inevitable. The thorax is convex and in addition offers no sufficiently fixed points for the taking of measurements. However, the accompanying graph (Fig. 259) has been prepared, the measurements of the thoracic width being taken between the apices of the middle coxal condyles, which mark approximately the greatest breadth and which are as nearly fixed as any points that can be found.

There are certain significant things revealed by the graph. It will be noted that in the majority of specimens the head is very slightly longer than the thoracic breadth, the variations being no greater than might be expected as the result of observational error. But in the two individuals from the wild boar and in the specimen from Switzerland the head-length is significantly greater than the thoracic breadth. This correlates with the

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greater actual head-length, the large size, the small paratergal plates, and the tendency toward weak pigmentation which is shown by these same specimens.

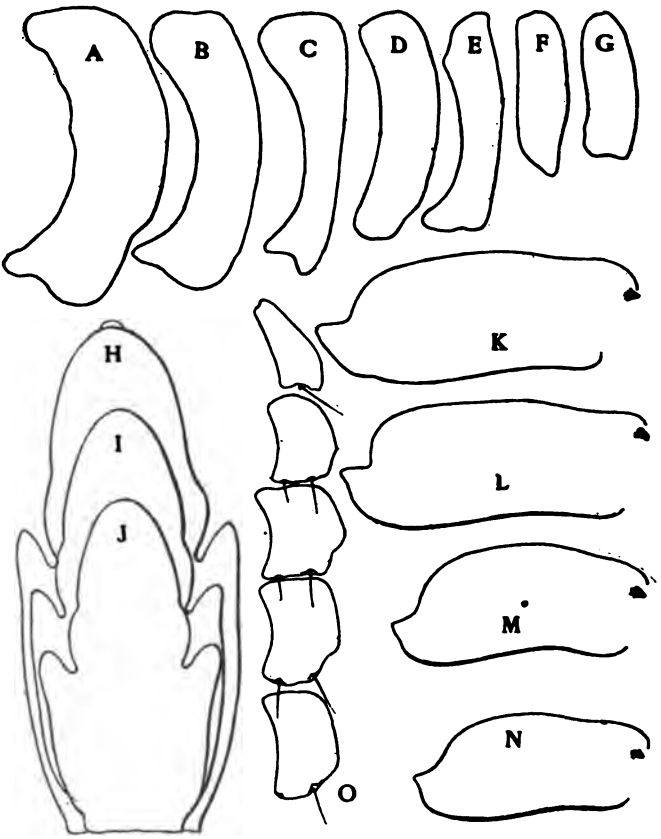

FIG. 258.—Paratergal plates of *Haematopinus suis* (Linnaeus), showing variation in size, based upon specimens from: *A*, England; *B*, Philippine Islands; *C*, Mexico; *D*, China; *E*, Switzerland; and of *H. aperis* n. sp., based upon specimens from: *F*, Piaget Collection; *G*, Hungary. *H*, *I*, *J*, heads of *Haematopinus suis* (Linnaeus), showing variation in size and form, including the greatest observed extremes and an intermediate. Posterior femora of *H. suis*, showing variation in size, based upon specimens from: *K*, Switzerland, and *L*, Philippine Islands; and of *H. aperis* n. sp., based upon *M*, specimen from Piaget Collection, and *N*, specimen from Hungary. *O*, normal paratergal plates of *H. suis*.

The specimen from Coyoacan, Mexico, is part of a lot included by Neumann in his *H. suis adventicius* and said by him to have the thorax wider than the length of the head.

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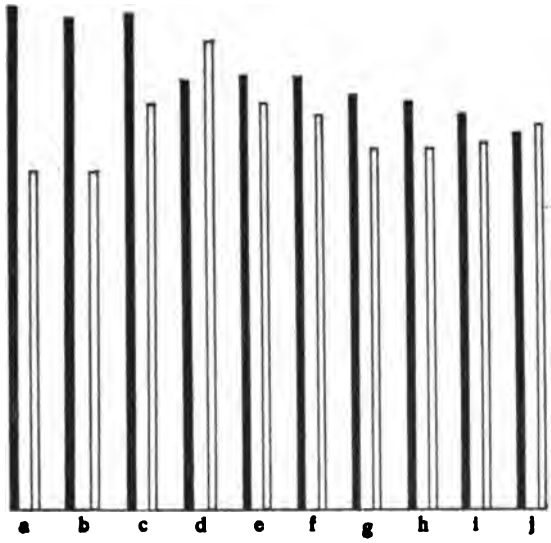

FIG. 259.—Graph showing variation in relative length of head and width of thorax in *Haematopinus aperis* n. sp., based upon specimens from: *a*, Piaget Collection, and *b*, Hungary; and in *H. suis* (Linnaeus) based upon specimens from: *c*, Switzerland; *d*, Larpur, India; *e*, Cambridge, England; *f*, Kwei Chou Fu, China; *g*, Ceylon; *h*, Philippine Islands; *i*, Coyoacan, Mexico; *j*, Penang, Federated Malay States. In this graph the solid bar represents head length, the light bar thoracic breadth.

Form of the sternal plate.—Both Fahrenholz and Neumann have utilized the form of the sternal plate in the separation of their supposed subspecies. The accompanying series of figures (Fig. 255), all drawn to the same scale with the aid of the camera lucida, includes all the forms figured by these authors. They have been arranged to show the transition from one extreme to the other. Figures *A* to *D* are from specimens of *H. aperis*. Figures *E* to *G* are from specimens from Switzerland of the form of *H. suis sardiniensis*, showing the degree of variation in three specimens from the same lot. Figure *H* is from a specimen from Weihaiwei, China, and forms a definite transition to Figure 255 *I*, which is from a specimen from the type lot of *H. suis chinensis*. Figures 255 *I*, *S*, and *U* are from this same lot and indicate something of the degree of variation to be seen. Figure 255 *L* duplicates almost exactly the figure given by Neumann for his *H. suis adventicius* and Figures 255 *Q* and *R* are from specimens belonging to lots which were referred by him to this form. Figure 255 *X*, from a specimen from Thüringen, Germany, duplicates the figure given by Fahrenholz for his *H. suis germanicus*.

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It is evident that, while the differences between the extremes shown are notable, there is a completely graded series between them. It would be entirely impracticable to attempt a division upon the basis of such characters, for while a particular type may recur or may even be associated with a particular locality, we should be forced to the recognition of an almost endless series of forms which could not be definitely separated.

It may be noted, however, that the rather distinctive form shown by the specimens from wild boar and from the material from Switzerland is associated with other characters which serve to set these specimens apart.

Form and extent of paratergal plates.—In Fig. 258 are presented figures showing a small series of isolated paratergal plates, these being in each case the plate of the sixth segment of a male. It is impossible to get an exact comparison, owing to the fact that the plates may assume various positions, but the results are sufficiently close for comparison. Had we but the extremes of the series, a separation would be simple, but the series is well graded and such gaps as exist could be filled up if desired. Again, however, it will be noted that the specimens from wild boar occupy an extreme position. In this form, as may be seen by reference to Figs. 252 *B* and 253 *B*, the plates tend to be widely separated, while in typical *H. suis* they form an almost continuous border on the abdomen.

Sclerotization and pigmentation.—Both *H. suis adventicius* and *H. suis chinensis* were characterized by their authors as "strongly chitinized." In the majority of the specimens at hand the dorsum of both males and females is strongly sclerotic and pigmented, and the markings of head and thorax are very dark. The pattern formed by the tergal plates of the abdomen is constant throughout, differences being merely of degree of sclerotization and pigmentation. There is evidently some variation which may be ascribed to differences in preparation and there is probably some normal variation in the insects, but there exist differences which may not be assigned to such causes. In all of the few available specimens from the wild boar the pigmentation is extremely weak or entirely lacking on the dorsum of the abdomen, and the specimens are elsewhere pale. In the single female from Penang, Malaysia, the dorsum of the abdomen is almost membranous. In the single female from Larpur, India, only certain plates are developed. In the specimens from Tübingen, Germany, the dorsum is exceedingly pale, the plates being scarcely or not at all discernible. The various specimens (Switzerland, France) which belong to the *sardiniensis* type are moderately pigmented.

Again, there is a correlation of this character with others in the specimens from the wild boar and from continental Europe, although it appears in other specimens as well.

Legs.—There are very obvious differences in the size of the legs. The

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short series of drawings here given (Fig. 258 *K–N*), all of which represent the second femur of males, will serve to illustrate the point. But there are curious discrepancies. The specimens from Switzerland, which in some respects approach most closely those from the wild boar, have the largest femora, while those from the wild boar have the smallest. Those from Los Baños, Philippine Islands, which represent something of an extreme in coloration and sclerotization, are intermediate.

Again there is a correlation in the specimens from the wild boar of this character with others. In other specimens it apparently does not correlate with other characters.

Combinations of characters.—It is evident that no single character which has been considered will suffice for any satisfactory separation of forms. Considered in combinations, however, there are some fairly clear results.

The specimens from wild boar, few, but taken at different times and in different places, agree in the combination of long head, comparatively small legs, small thorax, weak pigmentation, small paratergal plates, and narrow and rather pointed sternal plate.

The specimens from presumably domestic pigs from Switzerland, from domestic pigs from France(?), from "zebu" (Piaget Collection), and from "camel" (British Museum) constitute a fairly well-defined type, the paratergal plates being larger than in specimens from the wild boar, the size tending to be greater, the pigmentation darker, the legs larger, and the sternal plate essentially the same.

Other specimens are difficult to place in particular combinations, the characters being rather indiscriminately mixed, but in general the head tends to be shorter, the pigmentation more pronounced, the paratergites larger, the sternal plate broader.

Conclusions

From a consideration of the data here presented, together with the facts of the primitive distribution of the wild pigs, the writer has been led to certain conclusions. In forming them and translating them into nomenclatorial symbolism he has endeavored on the one hand to be practical and on the other to recognize the probable biological situation. The conclusions are as follows:

1. In all probability there were originally two well-marked forms of lice occurring on wild pigs, with possibly minor local forms. Of these two forms, one occurred on the wild boar of Europe, the other on the pigs of eastern Asia. There is unfortunately an enormous area in between concerning which we have no data.

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2. The majority of the lice on domestic pigs resemble most closely the Asiatic type, which is consistent with the known fact that our domestic pigs, as they exist today, have come in large part from Asiatic swine.

3. In continental Europe, however, there exists a type which in many respects approaches more closely the type from the wild boar. This may possibly be a hybrid or it may possibly represent a third primitive type.

4. As matters stand it seems practical to recognize nomenclatorially but two forms and to regard these as species, one including only the lice of *Sus scrofa,* the wild boar of Europe, the other including all lice on domestic swine. Such action does some slight violence to the facts in the case of the third type from continental Europe but is in accord with practical considerations.

5. There apparently being no name available for the species from *Sus scrofa,* it is here named *Haematopinus aperis.*

3. Haematopinus phacochoeri Enderlein

FIGS. 260, 261

1908. *Haematopinus phacochoeri* Enderlein, *Wissenschaftliche Ergebnisse der Schwedische Expedition nach dem Kilimandjaro, dem Meru, und den umgebenden Massaische Steppen,* 11:7–9; fig.

1911. *Haematopinus peristictus* Kellogg and Paine, *Bulletin of Entomological Research,* 2: 145–146; pl. 4, figs. 3–6 (part).

1912. *Haematopinus phacochoeri* Enderlein, Paine, *Entomological News,* 23:468 (part).

1916. *Haematopinus phachochoeri* Enderlein, Ferris, *Annals of the Durban Museum,* 1: 238 (part; specific name misspelled).

1916. *Haematopinus phachochoeri* Enderlein, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences* (4), 6: 145 (part; specific name misspelled).

1919. *Haematopinus phachochoeri* Enderlein, Bedford, *Director Veterinary Education and Research, Department of Agriculture, Union of South Africa, Report,* 5–6: 713 (part; name misspelled).

1927. *Haematopinus phacochoeri* Enderlein, Bedford, *ibid.,* 11–12: 737 (part).

PREVIOUS RECORDS. There is confusion in the published records of this species, owing to the failure of certain authors—notably Kellogg and Paine and the present writer—to recognize the fact that two distinct species of lice occur upon the African bush pigs and wart hogs. As nearly as may be determined, *H. phacochoeri* occurs normally only on the genus *Phacochoerus.* On this basis records may be allocated as follows:

Originally described by Enderlein from the region of Mount Kilimanjaro, from *Phacochoerus aeliani massaicus.* Recorded by Kellogg and Paine from *Phacochoerus aethiopicus,* Akamanga, North Nyasa; by Harms from *Phacochoerus* sp., German East Africa; by Bedford from *Phaco-*

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choerus sundevalli in Zululand and *P. aethiopicus* in the Transvaal. Other records of the species from *Potamochoerus* refer to *H. latus* Neumann.

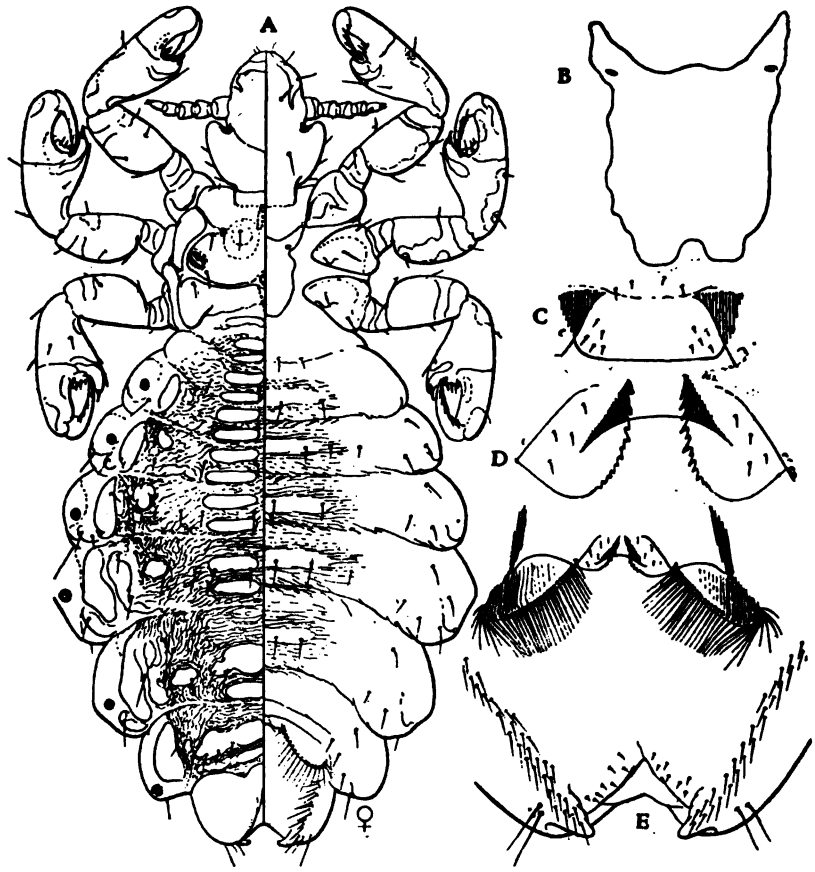

FIG. 260.—*Haematopinus phacochoeri* Enderlein: *A*, female; *B*, sternal plate of male; *D*, detail of vulva; *E*, genital region of female. *Haematopinus latus* Neumann: *C*, detail of vulva.

SPECIMENS EXAMINED. The types of *H. peristictus* Kellogg and Paine, from *Phacochoerus aethiopicus*, Akamanga, North Nyasa, and from "wart hog," northeastern Rhodesia (Stanford University and British Museum); "wart hog," East Africa, *E. J. Baxter*, and Gatdoma District, southern Rhodesia, *H. S. Lesson* (British Museum); "buffalo," Nakaru, Kenya Colony, *T. J. Anderson* (British Museum).

FEMALE (Fig. 260 *A*). Length, on the slide, attaining 6.5 mm. A strikingly marked and heavy-bodied species. Head relatively very small,

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short, being very little longer than broad, with very prominent post-antennal angles and with a pronounced occipital constriction which gives it a short "neck." *Thorax* about as long as the head and somewhat wider, being somewhat quadrilateral in form; sternal plate (Fig. 260 *B*) somewhat longer than broad, with the anterior angles produced and inclosing the openings of the sternal apophyses. Legs of the type common to the genus, strongly marked with bands of color.

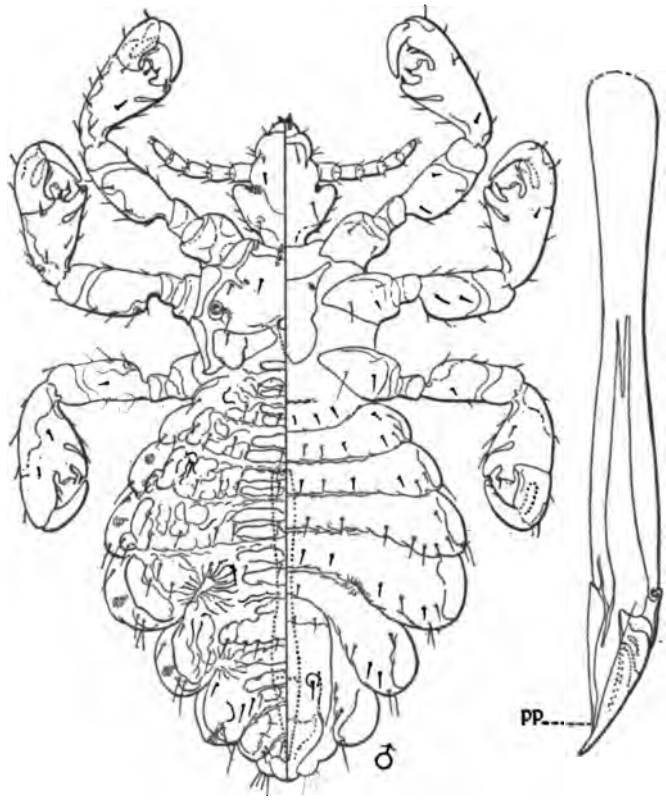

FIG. 261.—*Haematopinus phacochoeri* Enderlein, male and genitalia.

Abdomen broadly and regularly oval, with the margins strongly lobed by inter-segmental constrictions, especially between the sixth and seventh and seventh and eighth segments. Paratergal areas strongly sclerotic, but without well-defined plates. All tergites from the first to the eighth with two pairs of small median plates and those of the third to eighth segments with strongly defined, irregular, submarginal sclerotic areas. *Gono-*

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pophyses (Fig. 260 *E*) small, the vulva with a pair of serrate median lobes (Fig. 260 *D*), which are a distinctive characteristic of the species.

MALE (Fig. 261). In general closely resembling the female except for the smaller abdomen. Length, on slide, attaining 5.00 mm. Abdominal margin between sixth and seventh ventral segments more deeply incised than in female. Genitalia (Fig. 261) with the basal plate very long and slender, the apical parts small and obscure, presenting the usual V-shaped pseudopenis, but without any marked developments of the preputial sac.

NOTE.—The discussion of this species will follow the description of the next, which has been confused with it.

4. **Haematopinus latus** Neumann

FIGS. 260 *C*, 262

1909. *Haematopinus latus* Neumann, *Archives de Parasitologie*, **13**: 505; figs. 6–9.
1911. *Haematopinus peristictus* Kellogg and Paine, *Bulletin of Entomological Research*, **2**: 145–146 (part).
1912. *Haematopinus incisus* Harms, *Zoologischer Anzeiger*, **40**: 293.
1912. *Haematopinus phacochoeri* Enderlein, Paine, *Entomological News*, **23**: 468 (part).
1916. *Haematopinus phachochoeri* Enderlein, Ferris, *Annals of the Durban Museum*, **1**: 238 (misidentification; specific name misspelled).
1916. *Haematopinus phachochoeri* Enderlein, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences* (4), **6**: 145 (part; specific name misspelled).
1919. *Haematopinus phachochoeri* Enderlein, Bedford, *Director of Veterinary Education and Research, Department of Agriculture, Union of South Africa, Report*, **5–6**: 713 (part; specific name misspelled).
1927. *Haematopinus phacochoeri* Enderlein, Bedford, *ibid.*, **11–12**: 737 (part).

PREVIOUS RECORDS. Originally described by Neumann from *Potamochoerus africanus*, Kaporo, Nyasaland. Recorded by Kellogg and Paine (as *H. peristictus* K. and P., in part) from *Potamochoerus choeropotamus*, Fort Hill, North Nyasa; by Ferris (as *H. phacochoeri* Enderlein) from the same host, Ngxwala Hill, Ubombo, Zululand; by Harms (as *H. incisus* Harms) from *Potamochoerus affinis nyassae*, Msumwialager, German East Africa.

SPECIMENS EXAMINED. Those upon which the foregoing records by Kellogg and Paine and by Ferris were based and others from *Potamochoerus choeropotamus*, Luangwa Valley, Northeastern Rhodesia, *S. A. Neave* (British Museum).

FEMALE (Fig. 262). Length, on slide, attaining 5.00 mm. In all respects closely resembling the preceding species except in the form and certain other details of the abdomen. In this species the abdomen, instead of being broadly oval, is characteristically angular, widening to the sixth

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segment, the lateral lobes of which are very prominent, and then sharply narrowing again. Instead of two pairs of median tergal plates, as in *H. phacochoeri,* each segment bears but one pair. Correlated with these characters, the vulva (Fig. 260 *C*) presents a single median lobe instead of the two serrate lobes of *H. phacochoeri.*

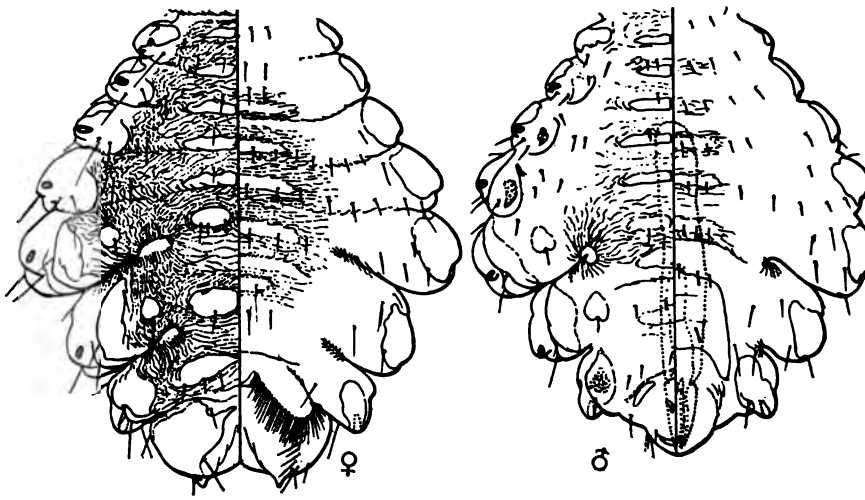

FIG. 262.—*Haematopinus latus* Neumann, abdomens of male and female.

MALE (Fig. 262). Length, on slide, 4.00 mm. Practically identical with the male of *H. phacochoeri* except in the angular form of the abdomen and the presence of but a single pair of median tergal plates on each abdominal segment.

NOTES.—The figures and descriptions given by Neumann and Harms are sufficiently clear to make the identity of their species certain. There can, I think, be no reasonable doubt that the two species, *H. latus* and *H. incisus,* are identical and that this species is distinct from *H. phacochoeri.* The characters which have been given permit the positive identification and separation of the two species.

Apparently *H. phacochoeri* is confined to species of the genus *Phacochoerus,* while *H. latus* occurs only on *Choeropotamus.* The two species show no very close resemblance to *H. suis* and *H. aperis,* which infest the species of the related host genus *Sus.*

5. Haematopinus eurysternus (Nitzsch)

FIGS. 263, 264

NOTE.—This species being a parasite of a domestic animal, there are numerous references to it in the literature of parasitology, few of which are of any significance from the point of view of this paper. No attempt is here made to list such references unless they add something to the records of distribution, the biology, or the systematics of the species.

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1818. *Pediculus eurysternus* Nitzsch, *Germar's Magazin der Entomologie,* 3: 305.
1829. *Haematopinus eurysternus* (Nitzsch), Stephens, *Catalogue of British Insects,* 2: 329.
1838. *Pediculus eurysternus* Nitzsch, Burmeister, *Genera Insectorum, Rhynchota, Species 14.*
1842. *Haematopinus eurysternus* (Nitzsch), Denny, *Monographia Anoplurorum Britanniae,* p. 29; pl. 25, fig. 5.
1874. *Haematopinus eurysternus* (Nitzsch), Giebel, *Insecta Epizoa,* p. 41; pl. 2, fig. 8.
1880. *Haematopinus eurysternus* (Nitzsch), Piaget, *Les Pediculines,* p. 648; pl. 53, fig. 1.
1891. *Haematopinus eurysternus* (Nitzsch), Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (old series), 7: 13; fig. 6.
1896. *Haematopinus eurysternus* (Nitzsch), Osborn, *ibid., Bulletin* (new series), 5: 172; fig. 100.
1908. *Haematopinus eurysternus* (Nitzsch), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 11.
1909. *Haematopinus eurysternus* (Nitzsch), Neumann, *Archives de Parasitologie,* 13: 498–500.
1913. *Haematopinus eurysternus* (Nitzsch), Patton and Cragg, *Textbook of Medical Entomology,* p. 549.
1916. *Haematopinus quadripertusus* Fahrenholz, *Archiv für Naturgeschichte,* 81 (Abt. A): Fasc. 11: 19; figs. 15–17 (August).
1916. *Haematopinus parviprocursus* Fahrenholz, *ibid.,* 81 (Abt. A): Fasc. 11: 21.
1916. *Haematopinus quadripertusus* Fahrenholz, *Zoologischer Anzeiger,* 48: 91 (October).
1916. *Haematopinus parviprocursus* Fahrenholz, *ibid.,* 48: 91.
1917. *Haematopinus eurysternus* (Nitzsch), Lamson, *Journal of Economic Entomology,* 10: 446.
1927. *Haematopinus eurysternus* (Nitzsch), Freund, *Prager Archiv für Tiermedizin,* 7(A): 43; fig. 2.

PREVIOUS RECORDS. From almost all parts of the world on domestic cattle.

SPECIMENS EXAMINED. Europe: four females and two males in the Piaget Collection (British Museum), "sur Bos taurus," these used as the basis for the accompanying figures. Africa: "off cows," Bathurst, Gambia, *Dr. Hood* (Molteno Institute); "off ox," Zululand, *H. H. Curson,* and Uganda, *A. W. N. Pillers* (British Museum). Asia: "tail of bullock," Ross Island, Andamans, and from *Cyon dukhensis,* Calcutta (Indian Museum); "off bullocks," Seychelles Islands, *P. R. Dupont,* and from "cattle," Kandy District, Ceylon, *J. C. Hutson* (British Museum); "off bullock," Rangoon, Burma, *Montant,* and "off bull," and "off calf," Khota Baru, Kelantan, Malay Peninsula, *G. D. Gimlette* (Molteno Institute); "off cow," Central Fukien, China, *Dr. J. P. Maxwell* (Molteno Institute). Australia: "tail of cow," Mackay, Queensland (British Museum). Pacific Islands: British Solomon Islands (British Museum); from dog, Honolulu, Hawaii, *E. M. Ehrhorn* (Molteno Institute and British Mu-

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seum). North America: "from cow," New Brunswick, New Jersey, Bishop, and Corozal, Panama Canal Zone, *L. H. Dunn* (Stanford University).

In addition to these a male labeled as "type" of *Haematopinus parviprocursus* Fahrenholz and a female labeled as "type" of *H. quadripertusus* Fahrenholz, received as a loan through the kindness of the Berlin Museum, have been examined.

FEMALE (Fig. 263). Length, on slide, from 3.5 to 4.75 mm. *Head* short and broad, strongly pigmented, with conspicuous pustulations about the bases of the dorsal setae; length only slightly greater than breadth; post-antennal angles very prominent; occipital region constricted into a

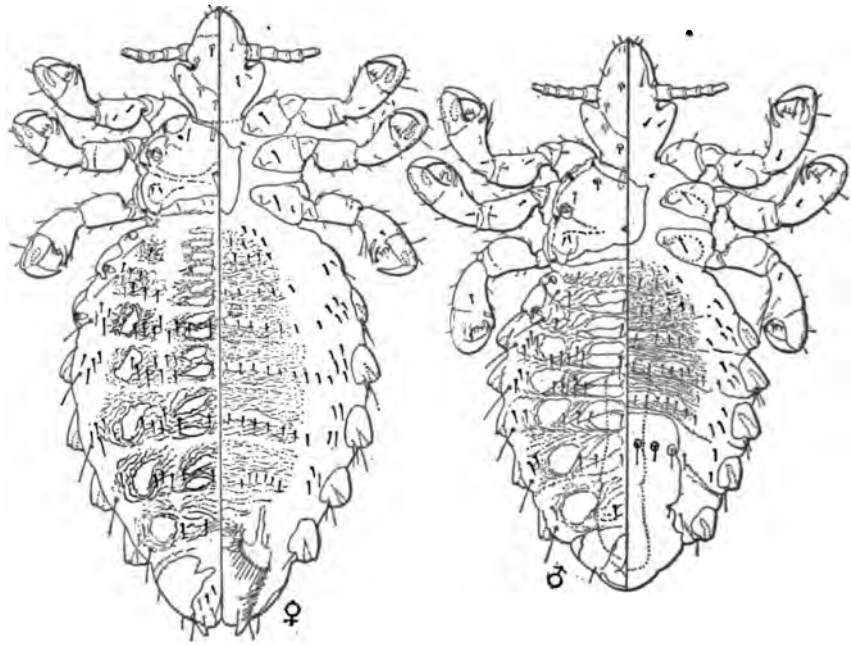

FIG. 263.—*Haematopinus eurysternus* (Nitzsch), male and female. From specimens in the Piaget Collection.

"neck." *Thorax* with the dorsum strongly and quite uniformly pigmented, the transverse, mesothoracic thickening but little darker than the remainder. *Sternal* plate (Fig. 264 *A–E*) somewhat variable in form but in general slightly longer than broad, quadrate and frequently with the anterior angles and the median point of the anterior margin produced. Sternal apophyses not included within the sternal plate. *Legs* strongly and uniformly pigmented, the tibial pad (pretarsal sclerite) very small.

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Abdomen elongate oval, usually rather membranous and pale except for the definitely sclerotic areas. Paratergites for the most part forming conspicuous, conical tubercles, those of the first apparent segment present

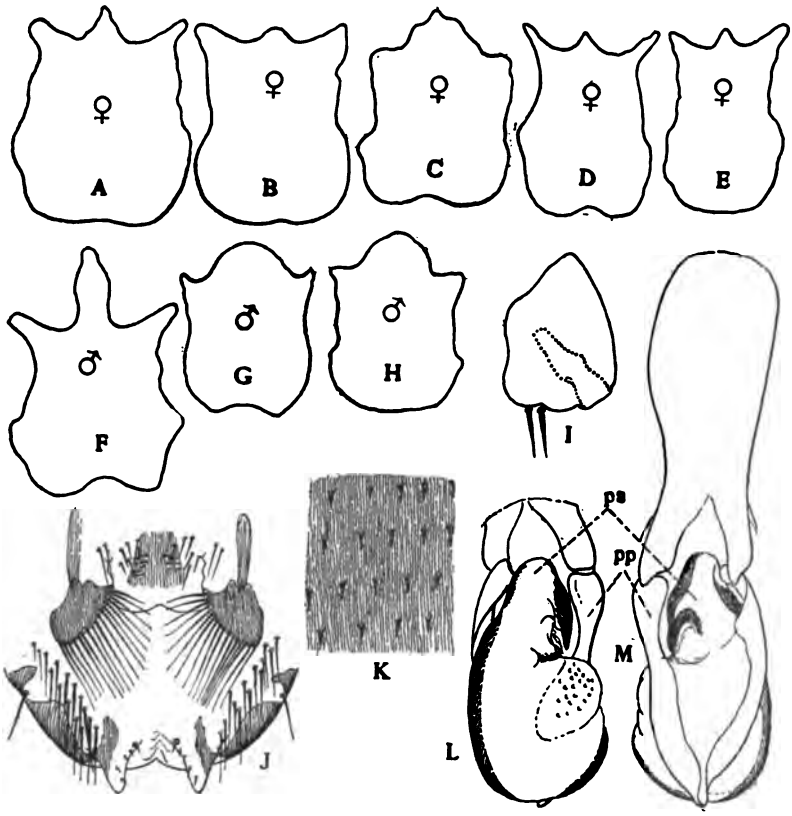

FIG. 264.—*Haematopinus eurysternus* (Nitzsch): thoracic sternal plates, showing variation in form, based upon specimens from: *A*, Panama Canal Zone; *B*, Rangoon; *C*, United States of America; *D*, Gambia; *E*, Khota Baru, India; *F*, Panama Canal Zone; *G*, specimen in Piaget Collection; *H*, from dog, Honolulu. *I*, paratergal plate, from specimen in Piaget Collection; *J*, genital region of female from specimen in Piaget Collection; *K*, ornamentation of derm; *L*, *M*, genitalia of male.

as minute plates. Tergites with two pairs of small, median plates on each segment and with a single, somewhat irregular submarginal plate. Dorsal setae rather numerous and conspicuous, forming something of a cluster between the median and submarginal and just outside of the marginal plates. Paratergites never with more than two or three setae along their posterior, ventral border. Furrowing of the derm somewhat variable,

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depending upon the degree of distention of the abdomen. Ventral side faintly sclerotic and furrowed. *Gonopophyses* (Fig. 264 *J*) rather small, blunt; wall of vagina with a median, quadrate, sclerotic area. Tracheal trunks unusually large and conspicuous.

MALE (Fig. 263). Length, on slide, ranging from 2.00 to 3.5 mm. In general form and characters closely resembling the female, but usually with the abdomen appearing much more strongly pigmented, owing perhaps to its lack of distention. Genital plate very large and conspicuous. *Genitalia* (Fig. 263 *L, M*) with the basal plate short and broad, the pseudopenis with the V-shape common to the genus, the preputial sac strongly sclerotic and forming basally a relatively huge hook.

NOTES.—Neumann (1909) called attention to the large size and the stronger pigmentation of specimens from Africa which he referred to this species. Fahrenholz (1916) considered such specimens to represent a distinct species, *H. parviprocursus*, the types of which, from "zweifellos eine Rinderart," were from Rehoboth, German Southwest Africa.

The material at hand presents a very wide range of size, the largest specimen (a female from Panama Canal Zone) being 1.5 times as large as the smallest of the same sex (Piaget Collection). There are also marked differences in pigmentation, some specimens being very much darker than others. Structurally they appear all to be identical. In general it is those specimens from the tropical regions which tend to be the larger: Canal Zone, female 4.75, male 3.25; Rangoon, females 4.75 and 4.5 mm.; Malay Peninsula, females 4.5 and 4.25, male 3.25 mm.; Gambia, females 4.5 mm.; Seychelles Islands, female 4.00, male 3.5 mm.; New Jersey, female, 3.5, male 2.5 mm.; Europe (Piaget material), female 3.00, male 2.00 mm. The specimens from the Seychelles and Ceylon are extraordinarily dark in color, but are structurally not different from the others.

Without some structural basis for a separation these forms can hardly merit recognition as distinct species. The species *H. quadripertusus* Fahrenholz was described from males only, from cattle, Banjo, Kamerun. The characters presented by it are duplicated in specimens at hand and it appears to be merely the male of the form described as *H. parviprocursus* Fahrenholz, which was based solely upon females. It will therefore also fall into synonymy.

The separation of *H. eurysternus* from *H. tuberculatus* (Burmeister) is a simple matter in spite of their close general similarity and their overlapping in size. A glance at the margin of the abdomen suffices; *H. eurysternus* never has more than two or three setae along the posterior margin of each paratergal plate, while *H. tuberculatus* has in the same place a row of at least five or six setae. This is correlated with other differences but is in itself precise as a "key character."

It will be noted that in the list of specimens examined there are included two anomalous records, one from dog at Honolulu and another from *Cyon dukhensis*, the "dingo," in India. There is nothing to do but accept these records at their face value and assume that occasionally this species may transfer to other animals.

Haematopinus sp.

One lot of material at hand, labeled as from "cow," Rangoon, Burma, VI: 1912, *Dr. H. H. Marshall* (Molteno Institute No. 131) is extremely puzzling. It repre-

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sents an exceedingly small species, length of female 2.5 and male 2.00 mm. It is in general similar to *H. eurysternus*, but the female especially differs in the weak development or even complete absence of the median tergal plates and the strong development of the submarginal tergal plates on the sixth to eighth segments. The material is not satisfactory and it seems best to leave it for some future student who may be better able to deal with it.

6. Haematopinus taurotragi Cummings

FIGS. 265, 266

1914. *Haematopinus taurotragi* Cummings, *Bulletin of Entomological Research*, 5: 155–159; 2 figs.

1916. *Haematopinus taurotragi* Cummings, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences* (4), 6: 146.

1927. *Haematopinus taurotragi* Cummings, Bedford, *Director of Veterinary Education and Research, Department of Agriculture, Union of South Africa, Report*, 11–12: 737.

PREVIOUS RECORDS. Originally described from specimens taken from *Taurotragus oryx* (*Boselaphus oreas*) in a menagerie in England. Recorded by Bedford from the same host, Drakensberg, Natal.

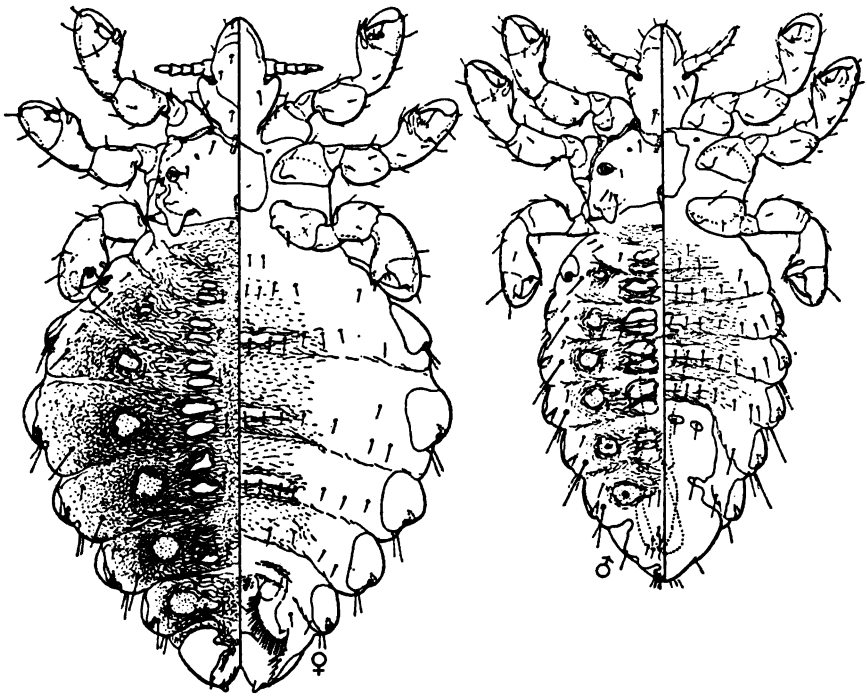

FIG. 265.—*Haematopinus taurotragi* Cummings, male and female.

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SPECIMENS EXAMINED. The types (British Museum) and other specimens from the same host, Natal, South Africa, *Lawrence Hill,* and Drakensberg, Natal, and zoölogical garden, Pretoria, *Bedford;* from "kudu," presumably *Strepsiceros kudu,* Grahamstown, South Africa, *Bedford.*

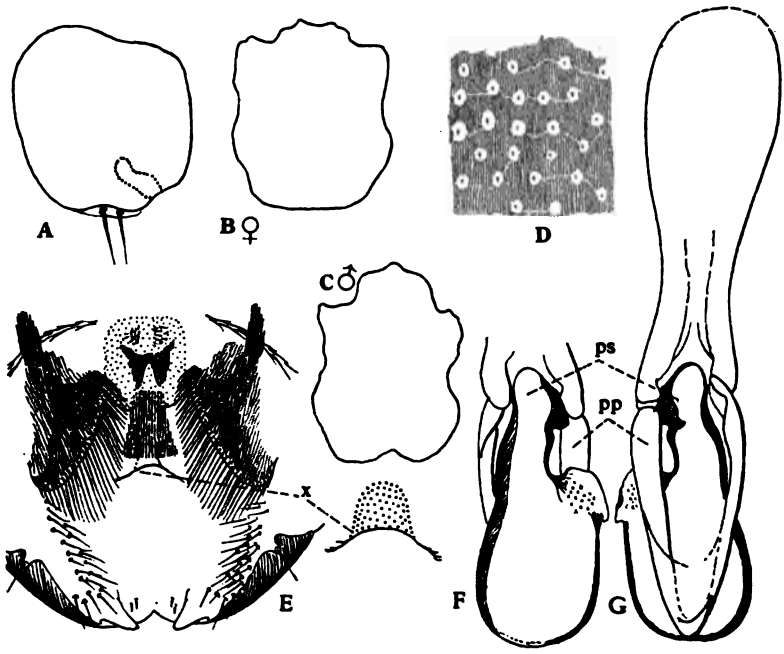

FIG. 266.—*Haematopinus taurotragi* Cummings: *A,* paratergal plate; *B,* thoracic sternal plate of female; *C,* thoracic sternal plate of male; *D,* ornamentation of derm; *E,* genital region of female; *F, G,* genitalia of male.

FEMALE (Fig. 265). Length, on slide, 3.5 to 4.00 mm. A stout-bodied species very closely resembling *H. eurysternus* (Nitzsch). It is in fact so very similar to the latter species that only the points of difference may be mentioned. Aside from somewhat intangible differences, such as the broader abdomen and the stouter and heavier legs, it presents the following precise differences: Second (apparent first) abdominal segment entirely without a paratergal plate. Gonopophyses (Fig. 266 *E*) somewhat halberd-shaped; the wall of the vagina with a very conspicuous sclerotic plate within the limits of which appears a more heavily sclerotic, somewhat W-shaped area; between the apices of the gonopophyses a crescent-shaped mark (Fig. 266 *Ex*) which is formed by the opening of a pit of unknown function that seems to be peculiar to this species; slightly anterior to this pit is a pigmented spot which seems sometimes to

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be lacking. Submarginal tergal plates marked almost throughout by small, pore-like openings (Fig. 266 *D*). Tracheal trunks much more slender than in *H. eurysternus*.

MALE (Fig. 265). Length, on slide, 3.00 to 3.5 mm. In general closely resembling the female, except for the narrower abdomen and the darker pigmentation due to the body not being distended. *Genitalia* (Fig. 266 *F, G*) similar to those of *H. eurysternus*.

NOTES.—While this species is certainly close to *H. eurysternus*, the differences which have been pointed out are constant and precise. The specimens from "kudu" are slightly smaller than those from *Taurotragus*, having the smaller measurements cited, but otherwise there are no differences.

7. **Haematopinus tuberculatus** (Burmeister)

FIGS. 267, 268, 269

1800. ? *Pediculus bufali-europaei* Latreille, *Histoire naturelle générale et particulière des Crustaces et des Insectes*, **8**: 96.
1839. *Pediculus tuberculatus* Burmeister, *Genera Insectorum, Rhynchota, Species 20.*
1852. *Haematopinus tuberculatus* (Burmeister), Lucas, *Annales de la Société Entomologique de France* (2), **10**: 529–533; pl. 11, No. 2.
1864. *Pediculus tuberculatus* Burmeister, Nitzsch, *Zeitschrift für die gesamten Naturwissenschaften*, **23**: 32.
1867. *Haematopinus tuberculatus* (Burmeister), Nitzsch and Giebel, *ibid.*, **28**: 397.
1869. *Pediculus punctatus* Rudow, *ibid.*, **34**: 167.
1874. *Haematopinus tuberculatus* (Burmeister), Giebel, *Insecta Epizoa*, p. 46.
1874. *Haematopinus punctatus* (Rudow), Giebel, *ibid.*, p. 47.
1880. *Haematopinus tuberculatus* (Burmeister), Piaget, *Les Pediculines*, p. 650: pl. 53, fig. 2.
1904. *Haematopinus tuberculatus* (Burmeister), Enderlein, *Zoologischer Anzeiger*, **28**: 140.
1908. *Pediculus ? punctatus* Rudow, Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 9.
1908. *Haematopinus tuberculatus* (Burmeister), Dalla Torre, *op. cit.*, p. 11.
1909. *Haematopinus tuberculatus* (Burmeister), Neumann, *Archives de Parasitologie*, **13**: 497–500; fig. 1.
1910. *Haematopinus punctatus* (Rudow), Mjöberg, *Arkiv för Zoologi*, **6**: 166.
1910. *Haematopinus phthiriopsis* (Gervais), Mjöberg, *ibid.*, **6**: 166; fig. 84 (misidentification).
1910. *Haematopinus tuberculatus* (Burmeister), Mjöberg, *ibid.*, **6**: 167.
1911. *Haematopinus tuberculatus* (Burmeister), Neumann, *Archives de Parasitologie*, **14**: 413.
1913. *Haematopinus tuberculatus* (Burmeister), Patton and Cragg, *Textbook of Medical Entomology*, p. 549; pl. 68, figs. 2, 7.
1913. *Haematopinus tuberculatus* (Burmeister), Johnston and Harrison, *Proceedings of the Royal Society of Queensland*, **24**: 106.
1916. *Haematopinus bufali* (De Geer), Fahrenholz, *Archiv für Naturgeschichte*, **81** (Abt. A): Fasc. 11: 7; pl. fig. 3 (misidentification).
1916. *Haematopinus punctatus* (Rudow), Fahrenholz, *ibid.*, **81** (Abt. A): Fasc. 11: 33.

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1916. *Haematopinus tuberculatus* (Nitzsch) [*sic*], Bodkin and Cleare, *Bulletin of Entomological Research*, 7: 188.
1916. *Haematopinus tuberculatus* Grib. [*sic*], Roubaud and Van Saceghem, *Bulletin de la Société de Pathologie Exotique*, 9.
1917. *Haematopinus bufali bufali* (De Geer), Fahrenholz, *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten*, 34, Beiheft 2: 4 (misidentification).
1917. *Haematopinus bufali punctatus* (Rudow), Fahrenholz, *ibid.*, 34, Beiheft 2: 4, 13.
1919. *Haematopinus bufali-europaei* (Latreille), Fahrenholz, *Zeitschrift für Angewandte Entomologie*, 6: 154–155.
1919. *Haematopinus tuberculatus* (Nitzsch) [*sic*], Banks, *Philippine Journal of Science*, 14: 171.

Previous Records. The description of *Pediculus bufali-europaei* Latreille was based upon specimens from "les buffles venus d'Italie," and that of *Pediculus tuberculatus* Burmeister upon specimens from "common buffalo or buffalo of India," this in each case being presumably *Bos bubalus* (*Bubalus buffelus, Bos buffelus*). It has many times been recorded from this host in Asia and in other localities (Africa, South America) into which it has been introduced. Also recorded, as *H. punctatus* (Rudow), from the yak (*Bos grunniens, Bos tibetanus*) and from camels.

Specimens Examined. Variously indicated as from "buffalo," "carabao," "*Bos bubalus*." Piaget Collection, without indication of locality, but without doubt part of the material recorded by him as from the zoölogical garden of Rotterdam. India: Rawalpindi, Punjab, *R. C. Cochrane* (Molteno Institute); Kasauli (Stanford University); Pandacan, *F. M. Howlett* (Molteno Institute); Kotang Factory (Indian Museum). Burma: Rangoon, *Dr. H. H. Marshall* (Molteno Institute). British North Borneo: Sekong River, *Dr. H. F. Conyngham* (Molteno Institute). Sumatra, *Dr. J. S. Koningsberg* (Molteno Institute). Malay Peninsula: Kota Baru, Kelantan, *Dr. G. D. Gimlette* (Molteno Institute). Java, *W. Grosshoff* (British Museum). China: Hongkong, *Adam Gibson* (British Museum); Kaihsien, Szchuen, *S. S. Stericker* (Molteno Institute). Philippine Islands: Central Mindanao and Los Baños, *Woodworth* (Stanford University); Alabang, *Mitzmain* (British Museum). Guam (Stanford University).

From camels: Punjab, India (Indian Museum); "camels imported from India, Perth, W. Australia, *Dr. J. B. Cleland*" (Molteno Institute), being part of the material recorded by Neumann (1911); without indication of locality (British Museum); Burao, British Somaliland, *Dr. R. E. Drake-Brockman* (British Museum).

Four specimens from the Hyslop Collection, now in the possession of the Faculté de Medecin of Paris, received as a loan through the kindness of Dr. E. Brumpt, labeled as from "Bison americanus," without further data, these being the specimens recorded by Neumann (1909) and which

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have served as the basis for the published records of Anoplura from this host.

Two slides, including a male and a female, from the Hamburg Museum collection, labeled "*Haematopinus punctatus* Rudow, Type, von *Bos Grunniens,* alte sammlung, 2.9.1868, H. Sch., H. Fahrenholz det., praep. 1914/16."

Four slides, including two females, a male, and a nymph, in the Hamburg Museum collection, labeled "*Haematopinus bufali* (De Geer), von *Bubalus caffer* Sparr. *alba,* Zool. Garten, Hambg., Zool. Gesellsch. ded. 11.11.1892, H. Fahrenholz det., praep. 1914/16."

Two slides, including male and female, in the British Museum, labeled "wild boar, Jogidia, Hazanibagh, 24 : iii : 13, *O. A. Smith.*"

FEMALE (Fig. 267). Varying in length from 3.5 to 5.5 mm., on the slide, the average being about 4.5 mm. A robust and typically deeply pigmented species that in general closely resembles *H. eurysternus,* having the same head form and the same distribution of the abdominal tergal plates. It can be separated from *H. eurysternus* by the one precise character of the number of setae at the margin of the abdominal segments caudad of the paratergal plates (Fig. 269 *D*), there being here a series of at least five or six—and usually eight or more—setae in *H. tuberculatus,* while there are but two or three in *H. eurysternus.* Correlated with this are other characters: the generally larger size; the form of the sternal plate (Fig. 269 *C*), which has the lateral margins emarginate in a characteristic manner, with the anterior angles produced laterally; the rather characteristic form of the submarginal tergal plates of the abdomen, which ordinarily have a small, appendage-like, posterior, mesal prolongation; the form of the gonopophyses (Fig. 269 *F*), which are more tapering, with their mesal margins sinuate; and the presence of a quite conspicuous, somewhat variably formed, sclerotic area between the apices of the gonopophyses. The submarginal tergal plates are beset in large part with minute squamate markings (Fig. 269 *E*).

MALE (Fig. 268). Length, on slide, varying from 2.5 to 4.00 mm. In general resembling the female and definitely distinguishable in the same manner. *Genitalia* (Fig. 269 *A, B*) essentially the same as in *H. eurysternus.*

NOTES.—The specimens in the collection of the Hamburg Museum which are supposed to be the types of *Pediculus punctatus* Rudow offer no basis for the separation of this species from *H. tuberculatus.* The specimens are pale, but it may here be noted that the same condition appears in other material in the Hamburg Museum collection. Apparently long immersion in the particular preserving fluid employed by that institution has tended to decolorize the specimens, for even such parts as the claws and the genitalia of the males are extremely pale. This condition is especially

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marked in *Haematopinus minor* Fahrenholz, which will be discussed later, and in the specimens from *Bubalus caffer* which Fahrenholz has identified as *Haematopinus bufali* (De Geer).

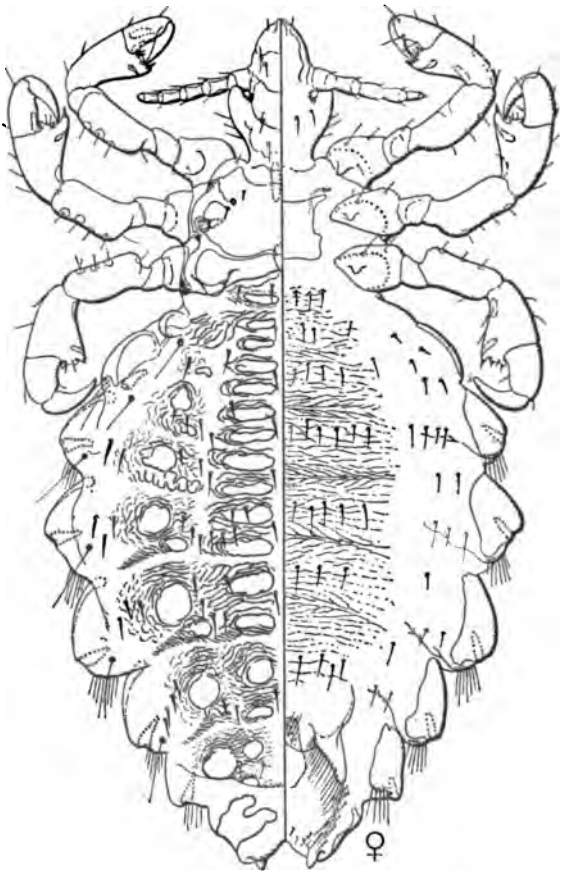

FIG. 267.—*Haematopinus tuberculatus* (Burmeister), female. From specimen in the Piaget Collection.

The question of the identity of *H. bufali* will be discussed more fully in connection with that species, but it may here be noted that in the writer's opinion the specimens in the Hamburg Collection identified by Fahrenholz as *H. bufali* are in reality *H. tuberculatus*.

It has previously been pointed out in connection with *H. suis* that the one specimen remaining in the Piaget Collection as a representative of his *H. tuberculatus* var. *penicillatus* is *H. suis*. Unfortunately this specimen does not agree with the description, which apparently refers to *H. tuberculatus*. Under the circumstances it seems best merely to allow the name *penicillatus* to lapse into oblivion.

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There remains one more disturbing nomenclatorial question, that having to do with *Pediculus bufali-europaei* Latreille. This species was described from "buffaloes from Italy," which were presumably *Bos bubalus,* and obviously is a species of *Haematopinus.* The inference is inescapable that this is the same as *H. tuberculatus,* for *H. eurysternus*—in all the material before me—is not represented by specimens from the buffalo. But, aside from its replacement of *H. tuberculatus* in a host-list published by Fahrenholz and one reference in an early list, the name *bufali-europaei* seems to have appeared in literature only in connection with the original description. On the other hand, a very considerable body of literature has been built up under the name of *H. tuberculatus.*

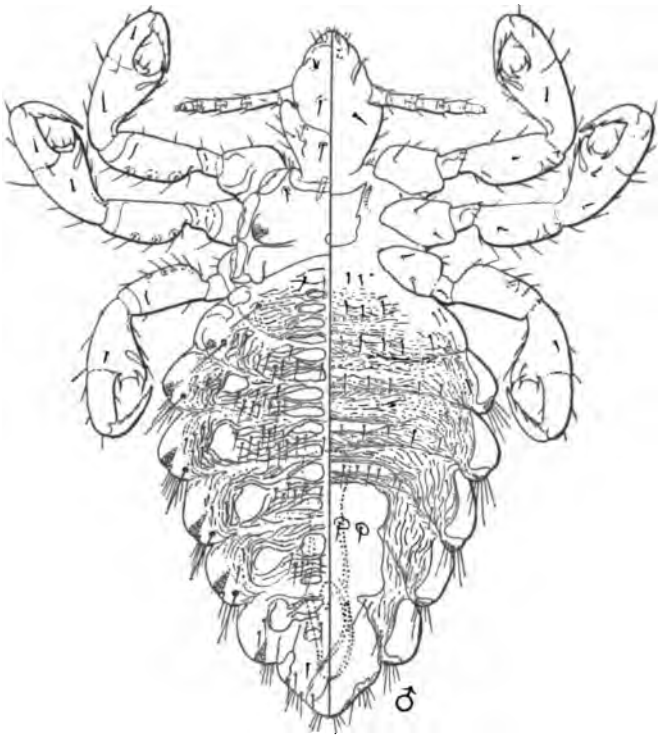

FIG. 268.—*Haematopinus tuberculatus* (Burmeister), male. From specimen in the Piaget Collection.

Under the circumstances, in spite of the fact that there is every reason to suppose that *H. tuberculatus* is a synonym of *H. bufali-europaei,* the writer refuses to displace the former name. He would hold that the case should be presented to the International Commission on Zoölogical Nomenclature with a request that the claims of priority be set aside in the interest of nomenclatorial stability.

No hesitation is here felt in placing all the specimens above recorded under a single species. Two lots from camel, including those from Australia and from the Punjab, India, differ from the typical form in being somewhat paler and smaller, being the smallest recorded above. In all other respects they are perfectly typical, and

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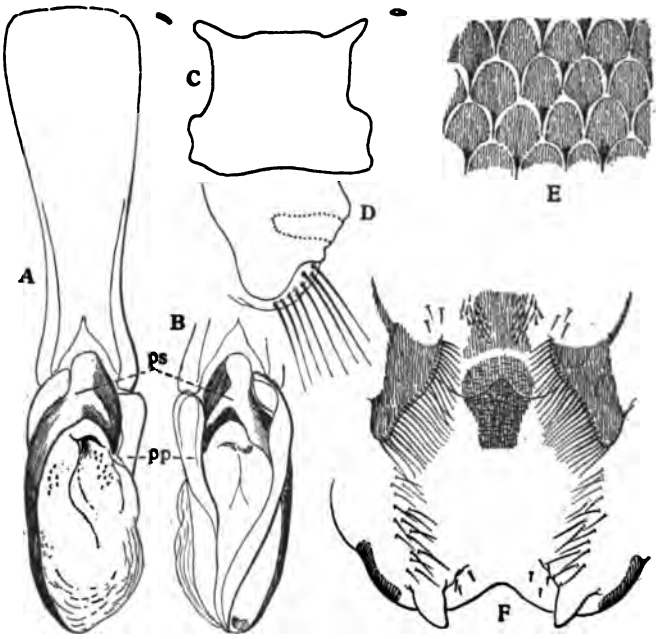

FIG. 269.—*Haematopinus tuberculatus* (Burmeister): *A, B,* genitalia of male; *C,* sternal plate of female; *D,* paratergal plate; *E,* ornamentation of derm; *F,* genital region of female.

the other specimens from camel are normal in all respects. The identification of this species with *Pediculus cameli* Linnaeus is utterly erroneous. *P. cameli* was based upon a figure given by Redi and is readily identifiable. It will stand as *Microthoracius cameli* (Linnaeus) and has been discussed elsewhere in this series.

8. Haematopinus bufali (De Geer)

FIGS. 270, 271, 272

1778. *Pediculus bufali* De Geer, *Memoires pour servir a l'histoire des Insectes,* **7**: 68; pl. 1, figs. 11–12.
1781. *Pediculus bufali-capensis* Fabricius, *Species Insectorum,* **2**.
1844. *Pediculus phthiriopsis* Gervais, in Walckenaer, *Histoire naturelle des insectes aptères,* **3**: 306.
1874. *Haematopinus phthiriopsis* (Gervais), Giebel, *Insecta Episoa,* p. 47.
1904. *Haematopinus phthiriopsis* (Gervais), Enderlein, *Zoologischer Anzeiger,* **28**: 141.
1908. *Haematopinus phthiriopsis* (Gervais), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum,* p. 11.
1909. *Haematopinus bufali* (De Geer), Neumann, *Archives de Parasitologie,* **13**: 500–505; figs. 2–5.
1915. *Haematopinus neumanni* Fahrenholz, *Archiv für Naturgeschichte,* **81** (Abt. A): Fasc. 11: 8.

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PREVIOUS RECORDS. Originally described by De Geer from Cape of Good Hope, "sur le Buffle d'Afrique." Recorded by Neumann from "buffalo," Katanga, Congo Free State, and Nyasaland (Nuttall Collection).

SPECIMENS EXAMINED. From *"Buffelus caffer,"* Nyasaland (British Museum); from "buffalo," Ruwenzori District, Nyasaland, *G. A. H. Bedford* (Stanford University); and part of both the lots recorded by Neumann (Molteno Institute).

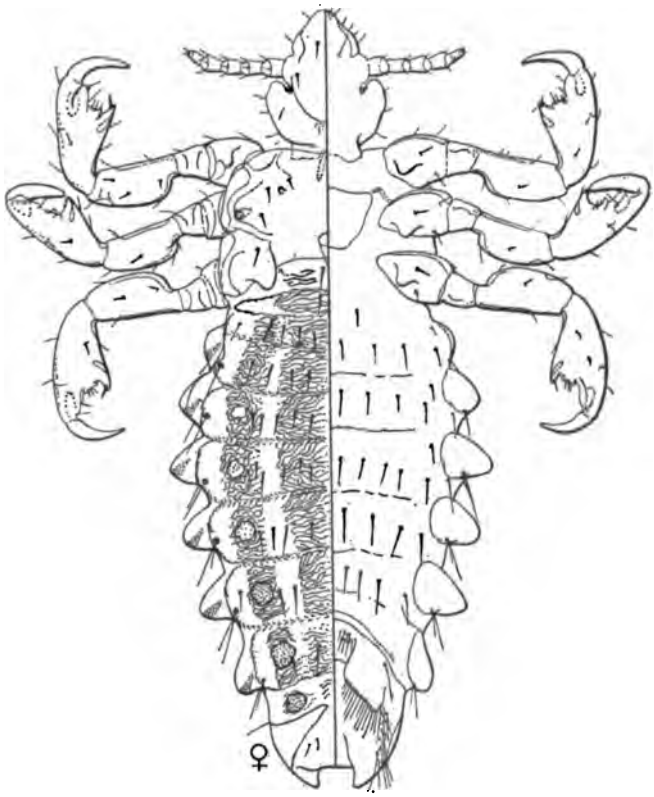

FIG. 270.—*Haematopinus bufali* (De Geer), female.

FEMALE (Fig. 270). Length, on slide, 4.00 to 4.5 mm. A very distinctive species because of its slender body, relatively enormous, sprawling legs, and very prominent abdominal paratergites. *Head* short and broad, the length only slightly exceeding the width, the post-antennal angles very prominent and rounded laterally, the occipital region constricted into a distinct "neck."

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Thorax distinctly quadrate, heavily pigmented; sternal plate (Fig. 272 *C*) somewhat trapezoidal, not inclosing the openings of the sternal apophyses. *Legs* relatively very large and long, not marked with bands and spots of deeper color.

Abdomen elongate and slender. Paratergites of the second (apparent first) segment entirely lacking; those of the third to eighth segments forming prominent, acute conical projections, the posterior margin of each plate bearing one or two small setae. Dorsum marked by four longitudinal, pigmented bands in which the furrowing of the derm is strongly developed; the mesal bands develop no distinct plates, but in the lateral bands small, circular, deeply pigmented plates appear. Ventral side membranous throughout. Gonopophyses (Fig. 272 *D*) pale and fringed irregularly with small setae.

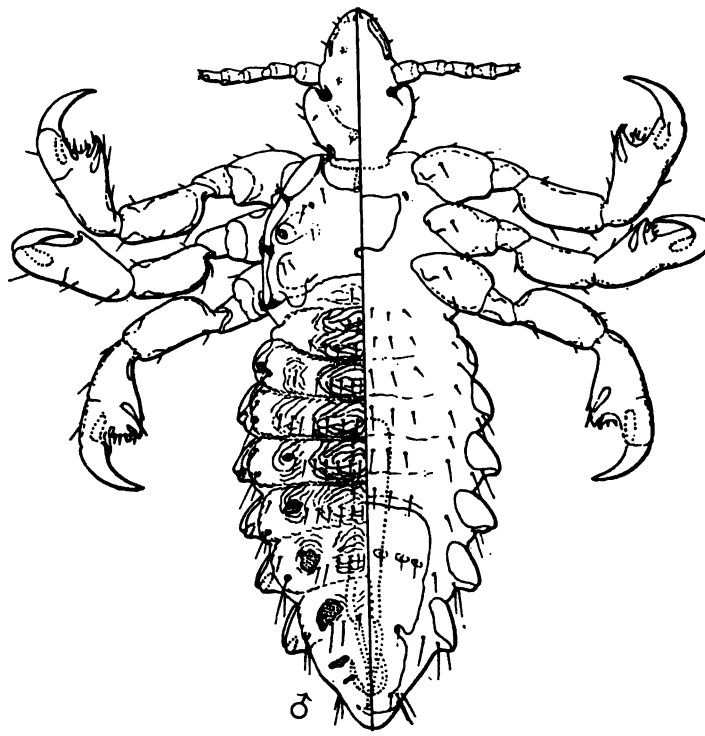

FIG. 271.—*Haematopinus bufali* (De Geer), male.

MALE (Fig. 271). Length, on slide, 3.5 to 4.00 mm. In general form and characters very similar to the female. Genital plate very large. *Geni-*

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talia (Fig. 272 *A, B*) with the V-shaped pseudopenis common to the genus, this elongate and slender; with the sclerotic portions of the preputial sac forming a narrow, irregular, hook-like rim and with a very small, strongly curved penis (*p*).

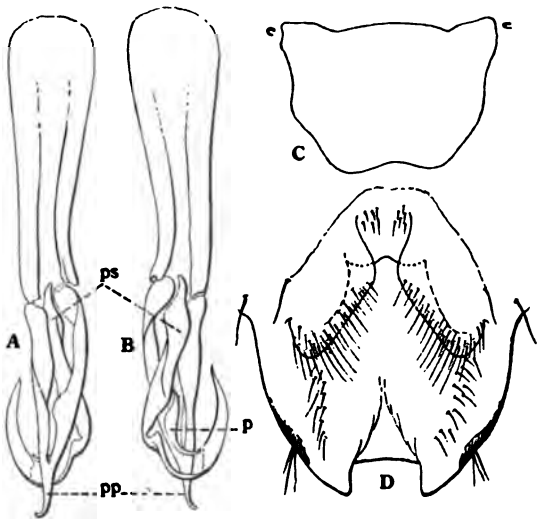

FIG. 272.—*Haematopinus bufali* (De Geer): *A, B*, genitalia of male; *C*, sternal plate of male; *D*, genital region of female.

NOTES.—An examination of the original description of *Pediculus bufali* has convinced the writer that Neumann was correct in his identification of the species. The description itself contains little information, but the characteristics of the species are striking and are indicated in De Geer's figures. He refers especially to the five pairs of lateral tubercles and his figure of the entire insect indicates these as they are in the specimens at hand. The size is stated to be "un peu plus petits que les Poux ordinaire des hommes," and the specimens at hand are in fact about as large as good-sized *Pediculus humanus*. The name *phthiriopsis* Gervais was merely a substitute for *bufali* and need not be considered further.

The writer, therefore, refuses to follow Fahrenholz in considering that Neumann misidentified this species. The name *H. neumanni* Fahrenholz is here placed as a synonym of *H. bufali*. The opinion is here maintained—based upon an examination of the specimens identified by Fahrenholz—that the *H. bufali* of Fahrenholz is merely *H. tuberculatus*. These specimens were taken in a zoölogical garden. It is unfortunate that the specific identity of the host has not in each case been positively established, it not being possible to say definitely that the specimens at hand from African buffaloes are from *Buffelus caffer*.

H. bufali is a very distinct form, having little in common with the other bovid-infesting species.

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9. Haematopinus asini (Linnaeus)

FIGS. 273, 274, 275 C

1674. *Pediculus asini* Redi, *Experimenta circa generationem insectorum*, pl. 21.
1758. *Pediculus asini* Linnaeus, *Systema Naturae* (ed. 10), p. 612.
1781. *Pediculus asini* Linnaeus, Fabricius, *Species Insectorum*, p. 476.
1787. *Pediculus asini* Linnaeus, Fabricius, *Mantissa Insectorum*, p. 368.
1804. *Pediculus asini* Linnaeus, Latreille, *Histoire naturelle générale et particulière des Crustaces et des Insectes*, 8: 99.
1805. *Pediculus asini* Linnaeus, Fabricius, *Systema Antliatorum*, p. 342.
1829. *Haematopinus asini* (Linnaeus), Stephens, *Catalogue of British Insects*, 2: 329.
1838. *Pediculus macrocephalus* Burmeister, *Genera Insectorum, Rhynchota, Species 18.*
1842. *Haematopinus asini* (Linnaeus), Denny, *Monographia Anoplurorum Britanniae*, p. 32; pl. 25, fig. 1.
1865. *Haematopinus equi* Simmonds, *Journal of the Royal Agricultural Society of England* (2), 1: 60.
1874. *Haematopinus macrocephalus* (Burmeister), Giebel, *Insecta Epizoa*, p. 44; pl. 2, fig. 5.
1880. *Haematopinus macrocephalus* (Burmeister), Piaget, *Les Pediculines*, p. 652; pl. 53, fig. 3.
1880. *Haematopinus macrocephalus* var. *colorata* Piaget, *ibid.*, p. 654.
1891. *Haematopinus asini* (Linnaeus), Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (old series), 7: 21; fig. 9.
1896. *Haematopinus asini* (Linnaeus), Osborn, *ibid., Bulletin* (new series), 5: 180; fig. 103.
1904. *Haematopinus asini* (Linnaeus), Enderlein, *Zoologischer Anzeiger*, 28: 141.
1908. *Haematopinus asini* (Linnaeus), Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 10.
1910. *Haematopinus asini* (Linnaeus), Mjöberg, *Arkiv för Zoologi*, 6: 167.
1916. *Haematopinus asini* (Linnaeus), Fahrenholz, *ibid.*, 47: 271.
1916. *Haematopinus elegans* Fahrenholz, *Archiv für Naturgeschichte*, 81 (Abt. A): Fasc. 11: 22; fig. 8 (August).
1916. *Haematopinus elegans* Fahrenholz, *Zoologischer Anzeiger*, 48: 90.
1916. *Haematopinus macrocephalus* (Burmeister), Fahrenholz, *Zoologischer Anzeiger*, 47: 271 (July).
1916. *Haematopinus minor* Fahrenholz, *ibid.*, 48: 90 (October).
1924. *Haematopinus macrocephalus* (Burmeister), Freund, *Prager Tierärztlicher Archiv*, 4(A): 52; fig. 6.

PREVIOUS RECORDS. From domestic horses in many parts of the world. From the zebra, *Equus burchelli*, Hamburg Zoölogical Garden.

SPECIMENS EXAMINED. The material in the Piaget Collection (British Museum), including five females, one male, and one immature specimen labeled "*Haematopinus macrocephalus*, sur un cheval," and three females and one male labeled "*Haematopinus macrocephalus* var. *coloratus*, sur un *Equus asinus*." North and South America: domestic horses, Florence, Montana, and San Jose, California (Stanford University); burro (donkey), Barranquilla, Colombia, *L. H. Dunn* (Stanford University). Africa:

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Equus caballus, Egyptian Sudan, and horse, Borao, British Somaliland, *Dr. R. E. Drake-Brockman* (British Museum). Australia: domestic horse, Sydney, New South Wales, *H. F. Clinton* (Stanford University). Burma: mules, N. Chin Hills (British Museum). Specimens in the British Museum labeled as *"H. eurysternus,* pres. by *J. E. Gray,"* without host or locality.

Also the types of *Haematopinus minor* Fahrenholz, "von *Equus burchelli* Gray. Zool. Garten Hamb. Zool. Gesellsch. ded. 26 . 5 . 1893. H. Fahrenholz det., praep. 1914/16," received as a loan through the kindness of Dr. Titschack of the Hamburg Museum.

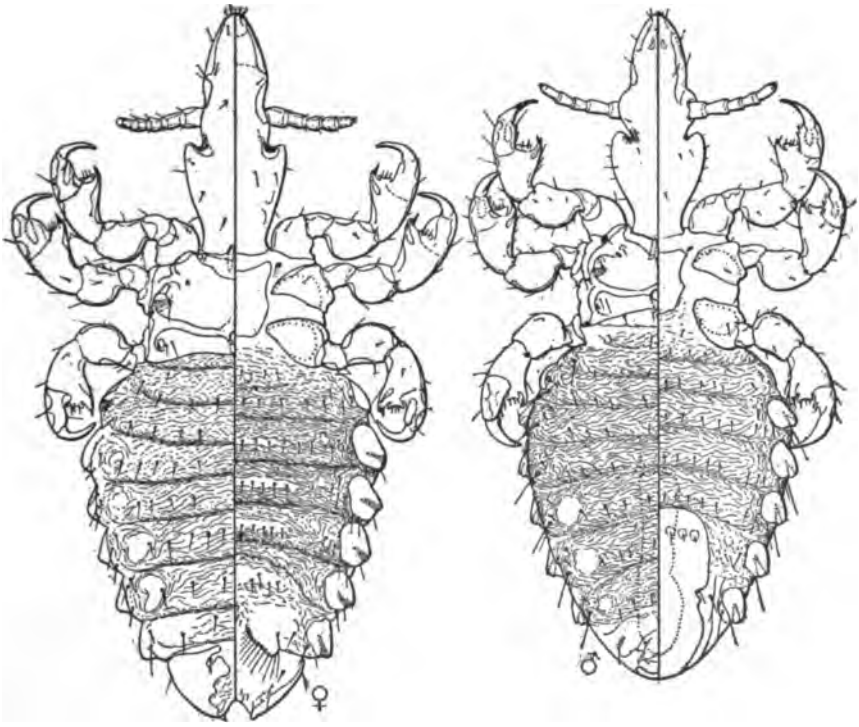

FIG. 273.—*Haematopinus asini* (Linnaeus), male and female.

FEMALE (Fig. 273). Length, on slide, from 2.5 to 3.5 mm. A very distinctive species by reason of the extraordinarily large and long head and comparatively small legs and body. *Head* nearly two and a half times as long as broad, the portion anterior to the post-antennal sinus somewhat longer than the remainder; post-antennal angles quite prominent; hind

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head with the lateral margins gracefully curved and sinuate, the head constricting into a "neck." Entire head quite strongly pigmented.

Thorax scarcely more than half as long as the head, quadrate, the dorsum strongly pigmented; sternal plate (Fig. 274 *H*) of quite constant form, quadrate, somewhat longer than wide, the lateral margins slightly convex, the anterior margin slightly emarginate; openings of ventral apophyses not inclosed within it. *Legs* short and stout, quite uniformly pigmented, the tibial pad (praetarsal sclerite) very small.

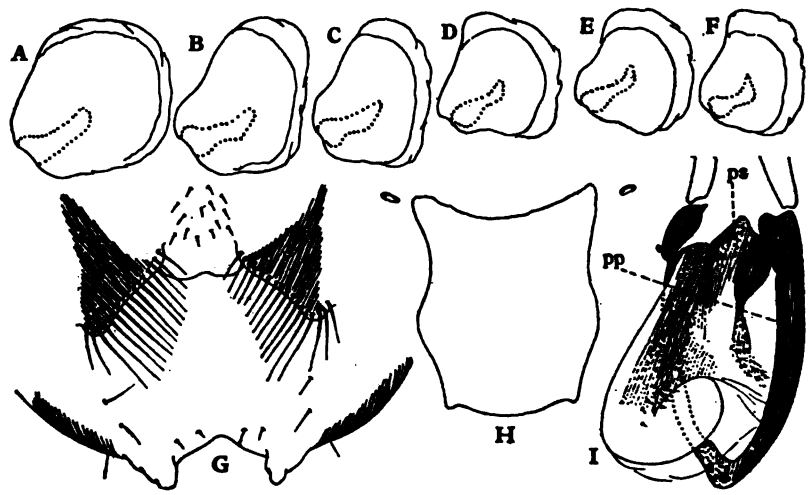

FIG. 274.—*Haematopinus asini* (Linnaeus): Paratergal plates, showing variation in size, based upon specimens from: *A*, horse in Piaget Collection; *B*, horse, California; *C*, horse, Montana; *D*, ass, Colombia; *E*, type of *H. asini coloratus* Piaget; *F*, ass, Colombia. *G*, genital region of female; *H*, sternal plate; *I*, genitalia of male.

Abdomen relatively small, quite deeply pigmented in typical examples that have not become greatly expanded; pleurites of the second (apparent first) segment lacking, those of the third to eighth segments forming small conical protuberances; tergal plates entirely lacking except for small submarginal areas developed on the fourth to eighth segments, these becoming progressively stronger posteriorly; derm thickly beset with small folds and wrinkles which are less conspicuous in more expanded specimens. Ventral side faintly sclerotic, likewise finely wrinkled; gonopophyses (Fig. 274 *G*) small and inconspicuous.

MALE (Fig. 273). Length 2 to 2.5 mm. In general very closely resembling the female. Genital plate large. *Genitalia* (Fig. 274 *I*) of the type characteristic of the genus, the pseudopenis bluntly V-shaped, the

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preputial sac with a heavy, slightly hooked knob which articulates with the basal plate.

NOTES.—This species is very distinct from the others of the genus, although in character of the genitalia of the male it approaches the bovid-infesting forms.

There is a certain amount of variation in size and coloration of the specimens at hand, but not enough to support any attempt at a division of the species. In Fig. 274 *A–F* are shown comparable paratergites from specimens of the same sex. While there is a noticeable difference in size, the intergradation is such as to make a separation impossible. Specimens at hand from donkeys (Colombia and Piaget Collection) tend to be slightly smaller and paler than those from horses, but there are no structural differences.

The specimens of *Haematopinus minor* are the smallest seen (female 2.5, male 2.00 mm.), but they are only slightly smaller than those from donkey and in addition are somewhat shrunken. In naming this species, Fahrenholz emphasized especially the paleness of color. As has previously been noted, there is a marked tendency toward paleness in specimens from the Hamburg Museum collection, apparently because of the particular preserving fluid there employed. In the specimens of *H. minor* even such normally dark regions as the claws are pale. There is no adequate basis for the separation of this species from *H. asini*.

Specimens of *H. elegans* Fahrenholz have not been available. This species was described from Gobabis, Southwest Africa, without indication of host other than the assumption that it would be some species of *Equus*. In the original description it is compared with *H. eurysternus* rather than *H. asini* and no basis is given for its separation from the latter. On the evidence of the figures it is very obviously nothing but *H. asini*.

10. Haematopinus acuticeps n. sp.

FIG. 275

SPECIMENS EXAMINED. Two females, type and paratype, from *Hippotigris* (= *Equus*) *burchelli*, Mpwapwa, Tanganyika Territory, received through the kindness of Mr. G. A. H. Bedford.

FEMALE (Fig. 275 *A*). Length, on slide, 5.5 to 5.75 mm. A species of form very similar to *H. asini*. *Head* (Fig. 275 *B*) of the same form as in *H. asini* (Fig. 275 *C*) and of the same length, but slightly more pointed anteriorly and apparently without the occipital apophyses of the latter. *Thorax* and legs essentially as in *H. asini*, but the sternal plate (Fig. 275 *D*) small and narrow. *Abdomen* relatively very large and swollen, the derm membranous and but weakly pigmented, setae few and minute. Ninth tergite with the usual sclerotic areas and the fifth to sixth tergites each with a small, faintly sclerotic submarginal area on each side. Paratergal plates strongly sclerotic, relatively small, the spiracles also small. Venter entirely membranous except for the conspicuous and strongly sclerotic gonopophyses, which are slender, tapering, and somewhat sickle-shaped. Ventral wall of the vagina with a pair of small, sclerotic areas.

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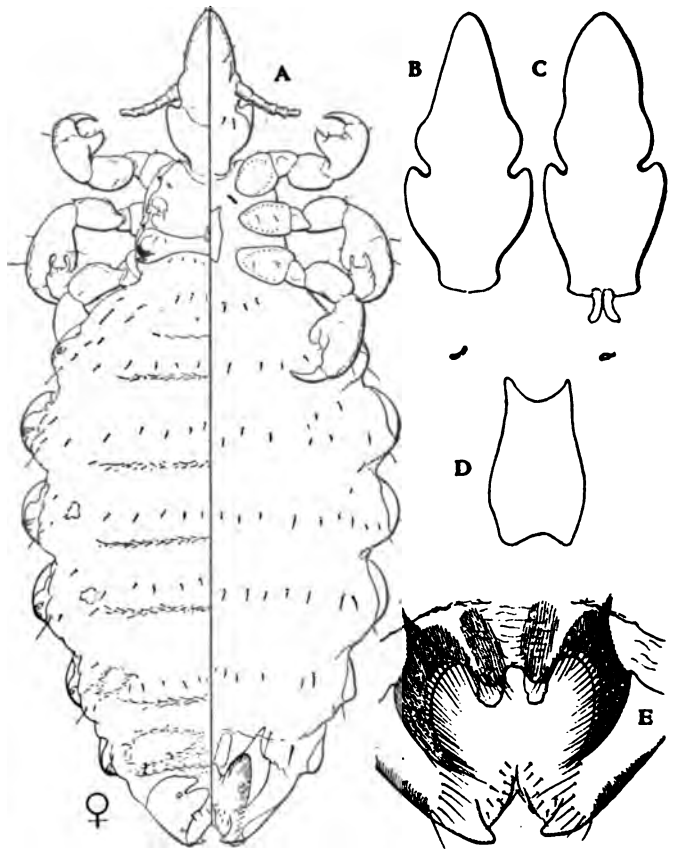

FIG. 275.—*Haematopinus acuticeps* n. sp.: *A*, female; *B*, outline of head; *D*, thoracic sternal plate; *E*, genital region. *Haematopinus asini* (Linnaeus): *C*, outline of head of female to same scale as *B*.

NOTES.—*Haematopinus minor* Fahrenholz is definitely ascribed to the same host as is *H. acuticeps*, and *H. elegans* Fahrenholz is also a presumably equid-infesting species and is recorded from Africa. But in spite of any presumption as to identity which might be suggested, it is evident that *H. acuticeps* is neither of these species, both being—in the opinion here adopted—clearly synonyms of *H. asini*, while *H. acuticeps* is equally clearly distinct. The difference in size is perhaps not significant, although the two specimens of *acuticeps* are nearly double the length of average *asini*, since practically all of this difference is in the abdomen, but the form of the sternal plate and, above all, that of the gonopophyses leave no room for question.

It is not probable that two distinct species of *Haematopinus* occur upon zebras. The types of *H. minor* Fahrenholz were taken in a zoölogical garden and may possibly have been stragglers from horses or asses. In any case there is no question of the distinctness of *H. acuticeps*.

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11. Haematopinus longus Neumann

FIG. 276

1912. *Haematopinus longus* Neumann, *Bulletin de la Société Zoölogique de France*, 37: 141; fig. 1.

1916. *Haematopinus longus* Neumann, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences* (4), 6: 144.

PREVIOUS RECORDS. Known only from the original description, from *Cervus unicolor*, Kota, Nepaul, India.

SPECIMENS EXAMINED. A single female, with the data of the types, received through the kindness of the Indian Museum.

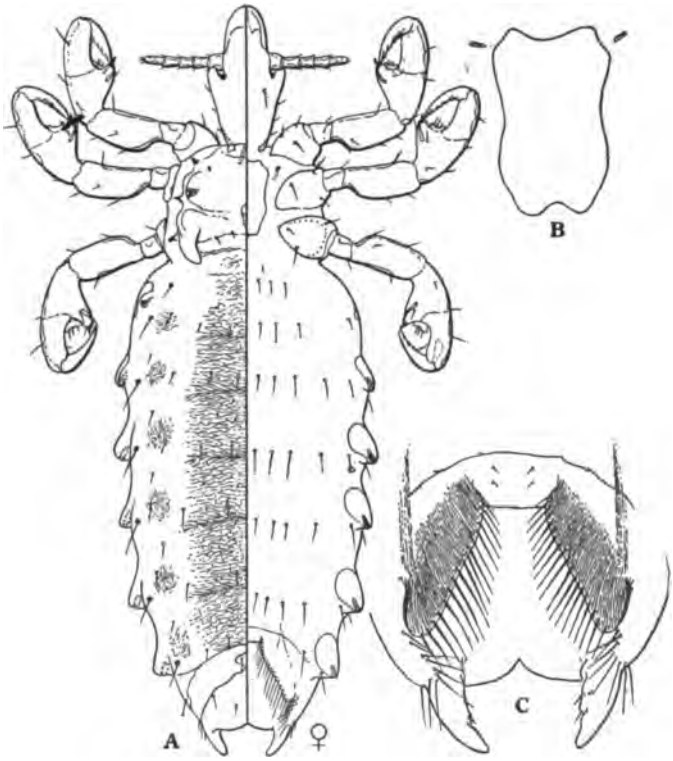

FIG. 276.—*Haematopinus longus* Neumann: *A*, female; *B*, thoracic sternal plate; *C*, genital region.

FEMALE (Fig. 276 *A*). Length, on slide, 4.5 mm. A very slender, pale species. Head rather slender, about twice as long as wide, the postantennal angles acute and forward-pointing, the hind head tapering regu-

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larly to the occipital margin. *Thorax* about as long as the head and about three times as wide, quadrate, the lobes at the posterior lateral angles unusually long. *Sternal plate* (Fig. 276 *B*) elongate, not inclosing the openings of the ventral apophyses. *Legs* normal.

Abdomen elongate and slender, with the paratergites forming small, widely separated, conical protuberances, those of the second (apparent first) segment lacking. Dorsum membranous, except for the usual areas on the ninth tergite, the derm showing only faintly pigmented and reticulated median longitudinal bands and still fainter submarginal spots. Venter entirely membranous; gonopophyses (Fig. 276 *C*) elongate, fringed with a single marginal row of setae.

MALE. The male is described by Neumann as essentially like the female, but with the abdomen shorter and relatively wider. The details of the genitalia are not described.

NOTE.—This is the only species of *Haematopinus* as yet recorded from members of the family Cervidae. It is a very distinct form and cannot be confused with any other of the known species.

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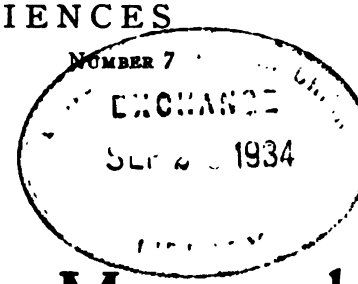

Contributions Toward a Monograph of the Sucking Lice

PART VII

By

GORDON FLOYD FERRIS

Associate Professor of Zoölogy

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SYSTEMATIC TREATMENT (Cont.)

Genus **ECHINOPHTHIRIUS** Giebel

1871. Giebel, *Zeitschrift für die gesamten Naturwissenschaften*, 37: 177.
1874. Giebel, *Insecta Epizoa*, p. 43.
1880. Piaget, *Les Pediculines*, p. 656.
1904. Enderlein, *Zoologischer Anzeiger*, 28: 136.
1906. Enderlein, *ibid.*, 29: 661.
1908. Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 17.
1909. Enderlein, *Deutsche Südpolar Expedition*, 10: 507.
1915. Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals*, Stanford University Publications, University Series, p. 51. (Genus erroneously ascribed to Enderlein.)
1916. Ferris, "Catalogue and Host List of the Anoplura," *Proceedings of the California Academy of Sciences* (4), 6: 181.
1928. Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord und Ostsee*, Teil XI*d*, p. 6.
1929. Ewing, *Manual of External Parasites*, p. 149.

Anoplura without eyes; with four-segmented antennae, which are not sexually dimorphic; with the legs all of essentially the same size and structure, very large and stout, the claw with a basal lobe; thorax with the notum reduced to at the most a slight median furrow and a median pit which is inclosed within the mesothoracic phragma, the sternum with an irregular, sclerotic but not free plate; abdomen entirely membranous in both sexes except for the ninth tergum and genital areas; paratergal plates entirely lacking; gonopophyses lacking; entire body thickly beset with setae which are for the most part short, stout, and thorn-like but are never modified into scales; spiracles present on the mesothorax and the third to eighth abdominal segments, rather small and provided with a specialized closing apparatus.

Hosts. Known only from the family Phocidae of the order Pinnipedia.

Type of the Genus. *Pediculus setosus* Burmeister, which is considered to be a synonym of *Pediculus horridus* Olfers.

Synonymical List of Names Previously Used in the Genus

Note.—Names in italics are synonyms of the name with which they are coupled.

fluctus **Ferris.**
Proechinophthirus fluctus (Ferris).
groenlandicus **Becher.**
Echinophthirius horridus (Olfers).

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horridus (Olfers).
Echinophthirius groenlandicus Becher.
Echinophthirius phocae (Lucas).
Echinophthirius sericans Meinert.
Echinophthirius sericeus Meinert (misspelling of *sericans*).
Echinophthirius setosus (Burmeister) (sometimes erroneously credited to Denny).
Haematopinus annulatus Schilling.
Haematopinus setosus (Burmeister) (sometimes erroneously credited to Denny).
Pediculus horridus Olfers.
Pediculus phocae Lucas.
Pediculus setosus Burmeister (not of Olfers).

microchir Trouessart and Neumann.
Antarctophthirus microchir (Trouessart and Neumann).

phocae (Lucas).
Echinophthirius horridus (Olfers).

sericans Meinert.
Echinophthirius horridus (Olfers).

sericeus Meinert (misspelling of *sericans*).
Echinophthirius horridus (Olfers).

setosus (Burmeister).
Echinophthirius horridus (Olfers).

NOTES.—Apparently but one species may definitely be referred to this genus. The genus has been utilized as the type of a family, the Echinophthiriidae, which includes all the species occurring on the Pinnipedia. The status of this family will be discussed in the final paper of this series.

There has been some difference of opinion concerning the characteristics of this genus, Enderlein (1909) assigning to it characters which are definitive rather of *Proechinophthirius*, stating that it has the *"Vorderbeine und ihre Klauen viel kleiner und zierlicher als die übrigen."* No basis appears for such a statement and the genus was certainly founded upon the species which is here recorded and described, whether that species be actually the *Pediculus horridus* of Olfers and the *Pediculus phocae* of Lucas or not.

The specialized closing apparatus of the spiracles will be considered in connection with the morphological section of this series.

1. Echinophthirius horridus (Olfers)[1]

FIGS. 277, 278

1816. *Pediculus horridus* Olfers, *De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius*, Part I, p. 84.

1834. *Pediculus phocae* Lucas, *Guerin's Magasin de Zoologie*, 4: Cl. IX; pl. 121, fig. 12.

1838. *Pediculus setosus* Burmeister, *Genera Insectorum, Rhynchota, Genus Pediculus, Species 12.*

[1] Owing to the rather close similarity of male and female in this and the other Pinniped-infesting species and to the excessive labor involved in preparing the figures of such elaborately spined and scaled forms, only one sex is figured completely in the case of all these species.

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1842. *Haematopinus setosus* (Burmeister), Denny, *Monographia Anoplurorum Britanniae*, p. 36.
1857. *Haematopinus annulatus* Schilling, Gurlt, *Archiv für Naturgeschichte*, **23**: 281.
1871. *Echinophthirius setosus* (Denny) [*sic*], Giebel, *Zeitschrift für die gesamten Naturwissenschaften* (2), **3**: 177.
1874. *Haematopinus (Echinophthirius) setosus* (Denny) [*sic*], Giebel, *Insecta Epizoa*, p. 42.
1878. *Haematopinus setosus* B. [*sic*], Gurlt, *Archiv für Naturgeschichte*, **44** (I): 167.
1878. *Haematopinus annulatus* Schilling, Gurlt, *ibid*, p. 167.
1880. *Echinophthirius setosus* (Lucas) [*sic*], Piaget, *Les Pediculines*, p. 656; pl. 54, fig. 1.
1886. *Echinophthirius groenlandicus* Becher, "Insecten von Jan Mayen," in *Die internationale Polarforschung 1882–1883. Beobachtungs-Ergebnisse*, **3**: 60; pl. 5, fig. 1.
1896. *Echinophthirius setosus* (Lucas) [*sic*], Osborn, *United States Department of Agriculture, Division of Entomology, Bulletin* (new series), **5**: 188.
1897. *Echinophthirius sericans* Meinert, *Vedenskabelige Meddelelser, Kjobenhavn*, **58**: 177.
1901. *Echinophthirius setosus* (Burmeister), Breddin, *Fauna Arctica*, **2**: 557.
1904. *Echinophthirius phocae* (Lucas), Enderlein, *Zoologischer Anzeiger*, **28**: 136.
1906. *Echinophthirius phocae* (Lucas), Enderlein, *ibid.*, **29**: 661.
1909. *Echinophthirius groenlandicus* Becker [*sic*], Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 17.
1909. *Echinophthirius phocae* (Lucas), Dalla Torre, *ibid.*, p. 17.
1909. *Echinophthirius sericeus* Meinert [*sic*], Dalla Torre, *ibid.*, p. 18. (Misspelling of *sericans*.)
1910. *Echinophtirus* [*sic*] *phocae* (Lucas), Mjöberg, *Arkiv för Zoologi*, **6**: 13: 176.
1916. *Echinophthirius groenlandicus* Becher, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 181.
1916. *Echinophthirius phocae* (Lucas), Ferris, *ibid.*, p. 181.
1916. *Echinophthirius sericeus* [*sic*] Meinert, Ferris, *ibid.*, p. 182. (Misspelling of *sericans*.)
1916. *Echinophthirius horridus* (Olfers), Ferris, *ibid.*, p. 205. (*Fide* Cummings.)
1919. *Echinophthirius horridus* (Olfers), Fahrenholz, *Jahresbericht des Nierersächsischen zoologischen Vereins zu Hannover*, **5–10**: 22.
1919. *Echinophthirius horridus* (Olfers), Ferris, *Report Canadian Arctic Expedition*, **3**: D: 11.
1928. *Echinophthirius horridus* (Olfers), Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee*, Teil XId, pp. 6–16; 11 t.f.
1928. *Echinophthirius groenlandicus* Becher, Freund, *ibid.*, p. 16.
1928. *Echinophthirius sericans* Meinert, Freund, *ibid.*, p. 17.

PREVIOUS RECORDS. Many times recorded from *Phoca vitulina* on the coasts of Europe; *Phoca groenlandica* and *Halichoerus gryphus*, Greenland; *Phoca variegata*, without indication of origin; *Phoca hispida*, Beaufort Sea, Alaska.

SPECIMENS EXAMINED. From *Phoca vitulina*, Shetland Islands, *Waterston* (British Museum and Stanford University), Edinburgh, Scot-

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land, *Evans* (British Museum), Hamburg Zoölogical Garden (Hamburg Museum); *Phoca hispida,* Beaufort Sea, Alaska (Stanford University); *Phoca richardii geronimensis,* Pacific Grove, California (Stanford University); "Greenland seal," without indication of origin (Stanford University).

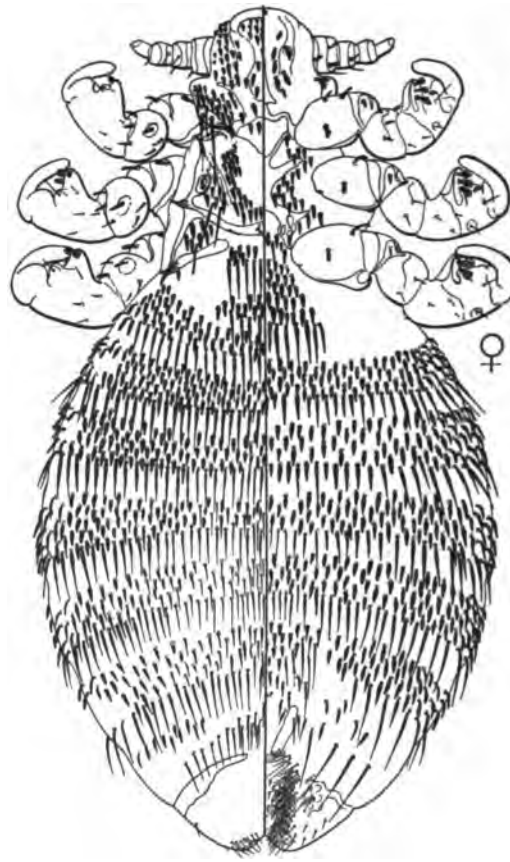

FIG. 277.—*Echinophthirius horridus* (Olfers), female. From specimen from *Phoca vitulina.*

FEMALE (Fig. 277). Length attaining 3.5 mm. *Head* short and broad, with prominent post-antennal angles and with the occipital region constricted into a relatively slender neck. Dorsum beset with numerous short, blunt setae and marked with a conspicuous sclerotic pattern; posterior-lateral angles with two or more long, stout setae. *Antennae* (Fig.

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278 *D*) with but faint vestiges of sensoria on the fourth segment; first and second segments each with a lobe on the ventral side.

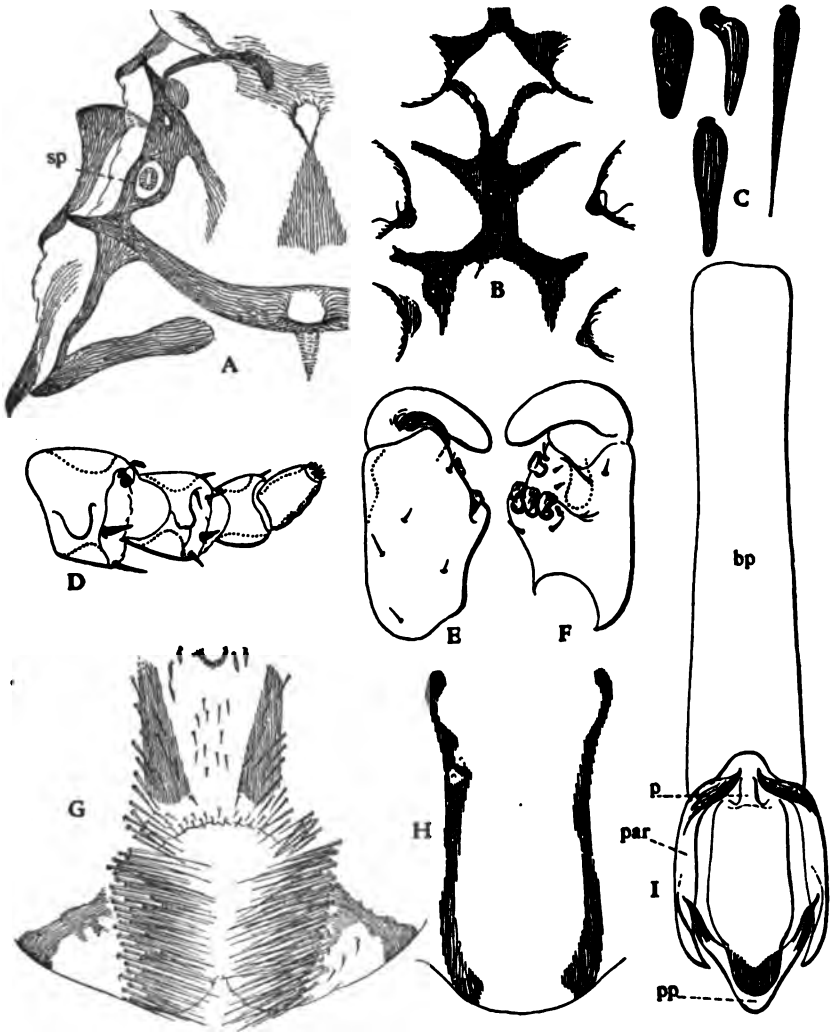

FIG. 278.—*Echinophthirius horridus* (Olfers): *A*, dorsum of thorax; *B*, sternum of thorax; *C*, types of setae; *D*, antenna; *E*, *F*, anterior tibio-tarsus; *G*, genital region of female; *H*, genital plate of male; *I*, genitalia of male.

Thorax (Fig. 278 *A*) with the phragmata strongly sclerotic and with heavy longitudinal bands connecting the coxal condyles; dorsum with numerous blunt setae; sternum (Fig. 278 *B*) with an irregular and some-

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what variable, branching, sclerotic area and numerous short, stout setae. Mesothoracic spiracle (Fig. 278 *A, sp*) small, but apparently functional. Legs all of the same type, the anterior pair but very slightly smaller than the others; tibia and tarsus (Fig. 278 *E, F*) entirely fused and the claw with a pronounced basal lobe.

Abdomen thickly beset with continuous segmental bands of short, blunt, flattened setae of various sizes (Fig. 278 *C*), which become more slender toward the posterior end of the body; each segment, both dorsally and ventrally, with a rather definite row of longer setae along the posterior margin; apex of the abdomen almost or quite bare; ninth tergite with a quite distinct, sclerotic band. Genital region (Fig. 278 *G*) with a pair of indistinct sclerotic plates, which are probably in the wall of the vagina; vulva bearing a number of small setae; gonopophyses entirely lacking; ninth sternite with two longitudinal areas of long, crowded setae. Spiracles very small, provided with a specialized closing apparatus.

MALE. Length attaining 3.00 mm. In all respects essentially like the female but with the abdomen more pointed. Genital plate (Fig. 278 *H*) somewhat lyriform, small. *Genitalia* (Fig. 278 *I*) with a long and rather broad basal plate (*bp*); parameres (*par*) simple, curved, enclosing between their apices the broadly V-shaped pseudopenis (*pp*); a flat, median structure lying between the parameres and partially overlapping the pseudopenis may be regarded as the statumen penis; the penis (*p*) lies between the bases of the parameres.

NOTES.—All the specimens at hand adhere very closely to a common pattern, the specimens from *Phoca richardii geronimensis* being only slightly smaller and slightly more hairy than those from the Atlantic area. They afford no basis for specific separation.

Authentic specimens of *E. groenlandicus* Becher and *E. sericans* Meinert have not been available, although a specimen from "Greenland seal" is at hand. However, the differences which are supposed to distinguish these species are so extremely trivial and in part come so evidently within the range of observed normal variation that they can hardly be taken seriously. There seems no good reason for continuing to carry these names along in the literature.

Genus **PROECHINOPHTHIRUS** Ewing

1923. Ewing, *Journal Washington Academy Sciences*, 13: 149.
1929. Ewing, *Manual of External Parasites*, p. 149.

Anoplura without eyes; with four-segmented antennae, which are not sexually dimorphic; anterior legs very small, with slender claw, middle and posterior legs very large and stout, with stout claw and with tibia and tarsus completely fused; thorax with the notum reduced

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to a median furrow and a median pit which is entirely inclosed within the mesothoracic phragma, sternum entirely lacking; abdomen membranous throughout, with the exception of small genital areas; paratergal plates entirely lacking; spiracles provided with a specialized closing mechanism; abdominal setae abundant, of varying forms and sizes, but none scale-like, for the most part irregularly arranged; gonopophyses entirely lacking.

HOSTS. From members of the family Otariidae of the order Pinnipedia.

TYPE OF THE GENUS. *Echinophthirius fluctus* Ferris, the only included species.

NOTES.—Following the suggestion made by the writer in connection with the original description of *Echinophthirius fluctus,* Ewing has separated this species into a genus by itself. While further discoveries may possibly serve to bridge the gap between this genus and *Echinophthirius,* the two appear at present to be quite distinct. Possibly the common possession of four-segmented antennae is not especially significant, since such a character has undoubtedly arisen quite independently at least three times in the Anoplura.

1. Proechinophthirus fluctus (Ferris)

FIGS. 279, 280, 281

1916. *Echinophthirius fluctus* Ferris, *Entomological News,* 27: 366–70; fig.
1923. *Echinophthirius fluctus* Ferris, McAtee, *North American Fauna,* 46: 142.
1923. *Proechinophthirus fluctus* (Ferris), Ewing, *Journal Washington Academy Sciences,* 13: 149.

PREVIOUS RECORDS. Originally described from specimens taken from a stuffed skin in the Museum of Stanford University, this skin bearing no data but identified by Dr. David Starr Jordan as that of a Steller sea lion, *Eumetopias jubata,* which is a native of the west coast of North America. Later recorded by McAtee and by Ewing from fur seal, *Callorhinus alascanus,* St. Paul and Pribilof Islands, Alaska. It is possible that the host was misidentified in connection with the original record.

SPECIMENS EXAMINED. The types; one female from *Callorhinus alascanus,* Alaska, 1919, *G. D. Hanna;* one female from the same host, Pribilof Islands, 1918, *H. Heath* (all in the Stanford University Collection).

MALE (Fig. 279). Length 2.5 mm. A comparatively slender and delicate species. *Head* relatively very large, with prominent post-antennal angles and with the occipital region slightly constricted; ventral side with a slightly raised gular region bearing a fringe of long setae; antennae

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(Fig. 280 *B*) as described for the genus; lateral margins of hind head with a pair of long setae. Thorax (Fig. 280 *A*) about as long and scarcely wider than the head, the sides nearly parallel, the mesothoracic phragma continuous across the notum, not inclosing the notal pit; coxal condyles connected by a continuous sclerotic band; sternum membranous except

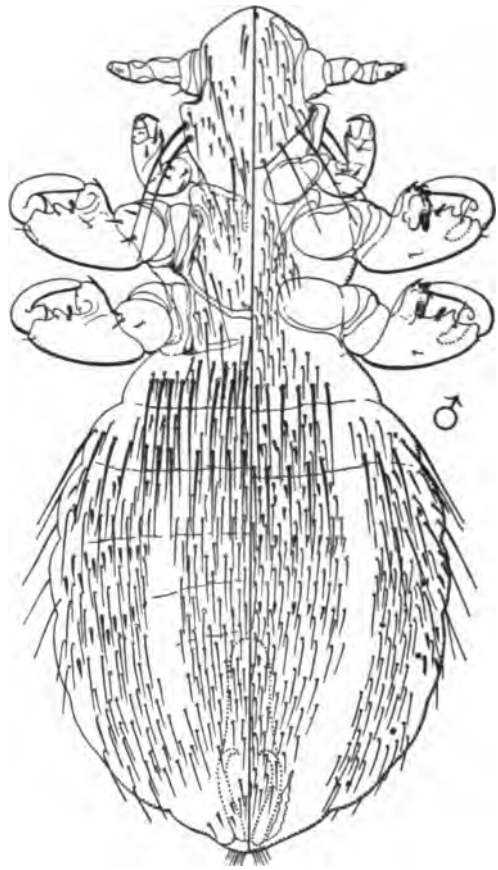

FIG. 279.—*Proechinophthirius fluctus* (Ferris), male.

for a sclerotic bar on each side between the fore and middle coxae; spiracle very small. Anterior legs small and weak, the tibia and tarsus distinctly separated, the claws slender (Fig. 280 *F*); middle and posterior legs large and stout, the tibia and tarsus closely fused, the claw broad, with a basal lobe.

Abdomen broadly oval, entirely membranous except for the almost vestigial genital plate, thickly beset with setae of various shapes and

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lengths, the first two apparent segments each with a fairly well-defined row of long setae, both dorsally and ventrally, and the marginal area of the anterior half of the abdomen dorsally and the median area ventrally with numerous thorn-like setae, the remaining setae slender. Spiracles (Fig. 280 *C*) provided with a specialized closing apparatus, the spiracular

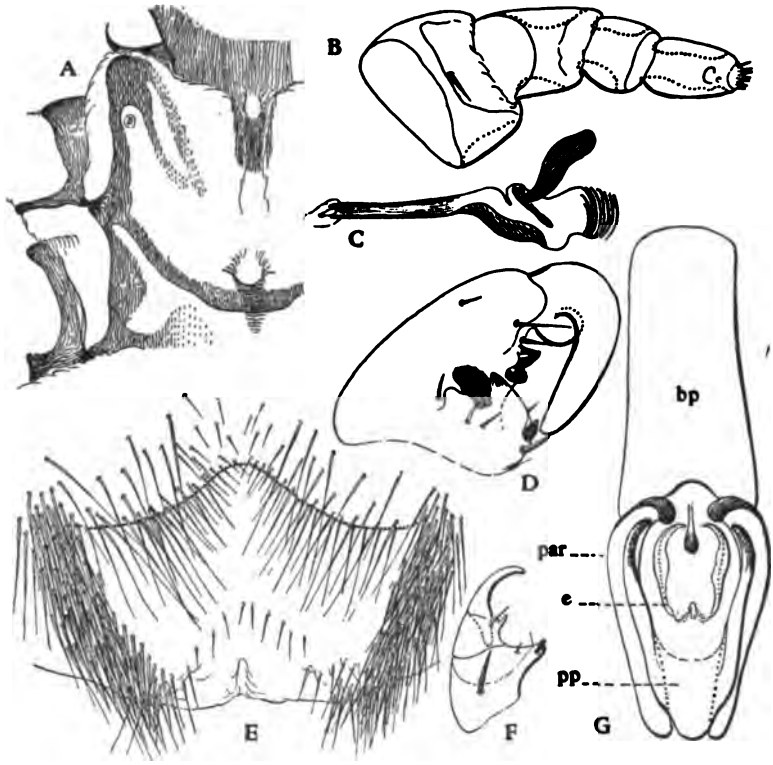

FIG. 280.—*Proechinophthirius fluctus* (Ferris): *A*, dorsum of thorax; *B*, antenna; *C*, abdominal spiracle; *D*, middle tibio-tarsus; *E*, genital region of female; *F*, anterior tibio-tarsus; *G*, genitalia of male.

opening very small, present on the third to eighth segments. Genitalia (Fig. 280 *G*) with the basal plate (*bp*) quite small, scarcely longer than the flattened parameres (*par*), to the bases of which the elongate V-shaped pseudopenis (*pp*) articulates; a rather vaguely defined endomeral piece (*e*) is present.

FEMALE. Length 2.75 mm. In general very closely resembling the male. Genital region (Fig. 280 *E*) with the vulva fringed with setae and with a crowded cluster of long setae on each side of the ninth sternite.

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IMMATURE STAGES. Specimens representing apparently two immature stages are available. One of the stages is the penultimate, certain individuals containing the developing adult. The two stages are essentially identical, differing only in size and in the older stage being somewhat more hairy.

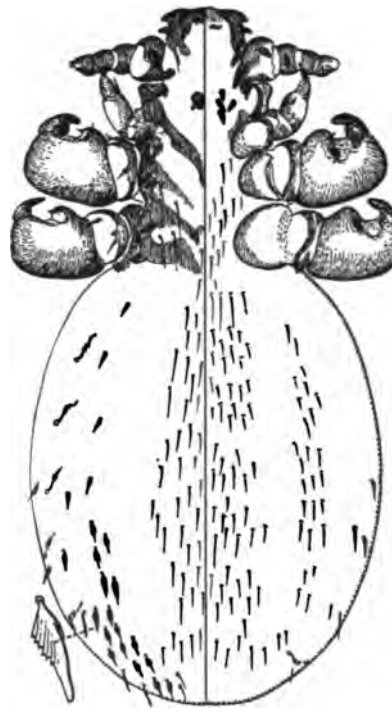

FIG. 281.—*Proechinophthirius fluctus* (Ferris), nymph.

In these (Fig. 281) the antennae are four-segmented as in the adult. The sclerotic areas of head and thorax are heavily pigmented and both head and thoracic dorsum are beset with numerous stout setae. The legs are substantially as in the adult. The abdomen is rather sparsely beset with small setae, some of which, toward the posterior end of the body, are flattened and more or less scale-like.

Genus **ANTARCTOPHTHIRUS** Enderlein

1906. *Antarctophthirus*, Enderlein, *Zoologischer Anzeiger*, 29: 661.
1908. *Antarctophthirus*, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 17.

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1909. *Antarctophthirus,* Enderlein, *Deutsche Südpolar Expedition,* 10: 508.
1910. *Arctophtirius,* Mjöberg, *Arkiv för Zoologi,* 6: 13: 177.
1915. *Antarctophthirus,* Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 48.
1916. *Antarctophthirus,* Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 182.
1928. *Antarctophthirus,* Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee,* Teil XId, p. 17.
1929. *Antarctophthirus,* Ewing, *Manual of External Parasites,* p. 148.

Anoplura without eyes; with five-segmented antennae, which are not sexually dimorphic; with the anterior legs small and weak, with slender claw and with the tibia and tarsus separated; middle and posterior legs very large and stout, the claw with a more or less well-defined basal lobe, the tibia and tarsus entirely fused; thorax with the notum reduced to at the most a slight median furrow and a pit which is inclosed by the mesothoracic phragma, the sternum without a sclerotic area; abdomen entirely membranous in both sexes; paratergal plates entirely lacking; gonopophyses lacking; entire body more or less thickly beset with stout, flattened setae and with scales; spiracles present on the mesothorax, but tending to be very much reduced, those of the abdomen present on the third to eighth segments and provided with a specialized closing apparatus.

Hosts. From members of the families Otariidae, Odobenidae, and Phocidae, of the order Pinnipedia.

Type of the Genus. *Antarctophthirus ogmorhini* Enderlein.

Synonymical List of Names Previously Used in the Genus

Note.—Names in italics are synonyms of the names with which they are coupled.

callorhini (Osborn).
Haematopinus callorhini Osborn.
Antarctophthirus monachus Kellogg and Ferris.
lobodontis Enderlein.
Antarctophthirus ogmorhini Enderlein. (Part; misidentification.)
microchir (Trouessart and Neumann).
Echinophthirius microchir Trouessart and Neumann.
monachus Kellogg and Ferris.
Antarctophthirus callorhini (Osborn).
ogmorhini Enderlein.
Echinophthirius setosus (Burmeister). (Misidentification.)
ogmorhini Enderleini. (Part; misidentification.)
Antarctophthirus lobodontis Enderlein.
trichechi (Bohemann).
Haematopinus trichechi Bohemann.
Arctophtirius trichechi (Bohemann).

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NOTES.—While there is a certain diversity among the members of this genus, it constitutes—in the opinion here adopted—a quite natural group, and there appears to be no reason for the recognition of the genus *Arctophtirius* Mjöberg once proposed with *A. trichechi* (Bohemann) as type. Representatives of four out of the five included species have been available to the writer.

1. Antarctophthirus ogmorhini Enderlein

FIGS. 282, 283

1902. *Echinophthirius setosus* (Burmeister), Rothschild, *Report of the Southern Cross Expedition*, p. 224. (Misidentification.)
1906. *Antarctophthirus ogmorhini* Enderlein, *Zoologischer Anzeiger*, 29: 662; 2 t.f.
1907. *Antarctophthirus ogmorhini* Enderlein, Neumann, *Deuxième Expedition Antarctique Française, Sciences Naturelles, Arthropodes*, p. 13. (Part.)

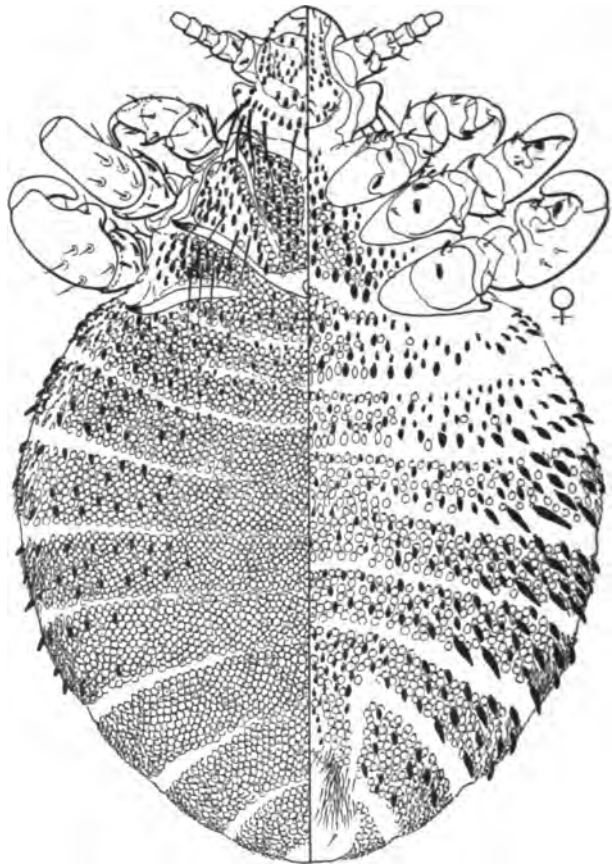

FIG. 282.—*Antarctophthirus ogmorhini* Enderlein, female. From type.

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1908. *Antarctophthirus ogmorhini* Enderlein, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 17.
1909. *Antarctophthirus ogmorhini* Enderlein, Enderlein, *Deutsche Südpolar Expedition*, 10: 509; figs. 174, 175, 181, 182.
1916. *Antarctophthirus ogmorhini* Enderlein, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 183.

PREVIOUS RECORDS. From *Ogmorhinus leptonyx*, Victoria Land and Booth Wandel Island, Antarctic.

SPECIMENS EXAMINED. The types, in the British Museum.

FEMALE (Fig. 282). Length 3.25 mm. A very plump, stout-bodied species. *Head* relatively small, with very prominent post-antennal angles and with the occipital region constricted into a distinct neck; dorsum with numerous, small, flattened, oval setae and with a definite sclerotic pattern; margins of hind head with several long, stout setae; ventral side of the head with small, oval setae only. Antennae presenting no unusual features.

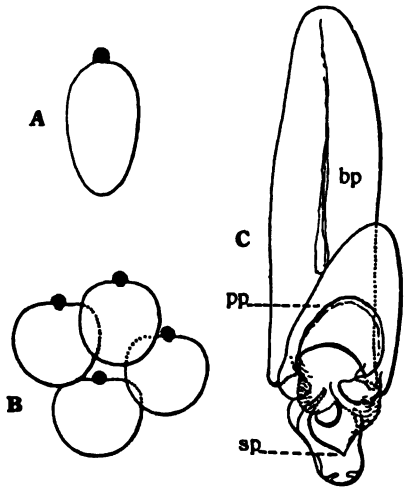

FIG. 283.—*Antarctophthirus ogmorhini* Enderlein: *A, B,* types of scales; *C,* genitalia of male.

Thorax slightly longer than the head and much broader, trapezoidal in form, both dorsum and venter beset with many small, oval, flattened setae and numerous scales. Legs with the basal lobe of the middle and posterior claws very much reduced; tibio-tarsal articulation entirely obsolete; the thumb on the middle and posterior legs without stout, modified setae. Mesothoracic spiracle very minute.

Abdomen subcircular, sparingly beset above on the lateral third of the first to sixth segments with small, oval, flattened setae; remainder of

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the dorsum thickly and uniformly beset with small, slightly pigmented scales which are of a very uniform subcircular shape. Venter rather sparsely beset throughout with flattened setae, those near the lateral margins being larger and stouter than the others; scales (Fig. 283 *A, B*) much fewer than on the dorsum, some of those along the posterior borders of the segments being slightly larger and longer than the others. Gonopophyses lacking; ninth sternite with two clusters of crowded setae.

MALE. Length 2.75 mm. Differing from the female chiefly in having the abdomen more pointed and the abdominal setae slightly larger and perhaps slightly more numerous. *Genitalia* (Fig. 283 *C*) distorted in the specimen examined; in this the parameres do not show and the V-shaped pseudopenis is turned back; it incloses a small sclerotic piece (*sp*), which may be regarded as the statumen penis.

NOTES.—Unfortunately not as many details as might be desirable were figured by the writer when the types were examined at the British Museum, no figure being made of the genital region of the female. The species should be easily recognizable, however.

2. Antarctophthirus lobodontis Enderlein

FIG. 284

1907. *Antarctophthirus ogmorhini* Enderlein, Neumann, *Deuxième Expedition Antarctique Française, Sciences Naturelles, Arthropodes,* p. 13. (Part; misidentification.)

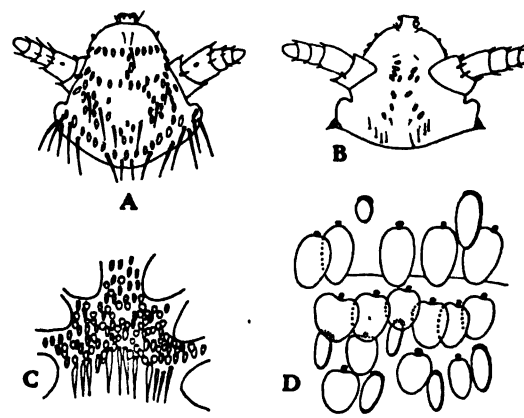

FIG. 284.—*Antarctophthirus lobodontis* Enderlein: *A,* dorsal aspect of head; *B,* ventral aspect of head; *C,* thoracic sternum; *D,* types of scales from abdomen. After Enderlein.

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1909. *Antarctophthirus lobodontis* Enderlein, *Deutsche Südpolar Expedition,* 10: 510; t.f. KK–NN.

1916. *Antarctophthirus lobodontis,* Enderlein, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 183.

1928. *Antarctophthirus lobodontis* Enderlein, Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee,* Teil XId, p. 20; figs. 14–16.

PREVIOUS RECORDS. From *Lobodon carcinophagus,* Booth Wandel Island, Antarctic.

SPECIMENS EXAMINED. Not seen by the writer.

NOTES.—It is possible here only to quote the original description and reproduce its accompanying figures. According to Enderlein the species differs from *A. ogmorhini,* with which it was at first confused, in the following particulars:

"Unterseite des Kopfes [Fig. 284 *B*] mit weniger Dornen, im wesentlichen nur 2 einander nahe gerückte Längsreihen der kurzen Dornen; am vorderen ende 2 Haare; hinten jederseits 4 Borsten. Kopfoberseite [Fig. 284 *A*] in der mitte mit 7 langen Borsten im gegensatz zu 2–3. Der Hauptunterschied ist der, dasz die Dornen des Hinterrandes des Thorakalsternum [Fig. 284 *C*] sich sehr lang und spitz ausgezogen haben. Die Schuppen der Ober- und Unterseite des Thorax und Abdomen sind verhältnismäszig lang und weniger verbreitert; Textfig. [284 *D*] zeigt Schuppen von der Ventralseite des Abdomen an der Grenze zwischen Sternit 2 und Sternit 3. Textfig. [284 *C*] solche vom Sternum des Thorax. Auf der Oberseite des Thorax fehlen die Dornen nahe der Mittellinie und sind durch Schuppen ersetzt."

Length of the female 2.5 mm.

3. Antarctophthirus microchir (Trouessart and Neumann)

FIGS. 285, 286

1888. *Echinophthirius microchir* Trouessart and Neumann, *Le Naturaliste,* 10: 80–81; figs.

1906. *Antarctophthirus microchir* (Trouessart and Neumann), Enderlein, *Zoologischer Anzeiger,* 29: 663–65; figs. 3, 4.

1908. *Antarctophthirus microchir* (Trouessart and Neumann), Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum,* p. 17.

1909. *Antarctophthirus microchir* (Trouessart and Neumann), Neumann, *Archives de Parasitologie,* 13: 537.

1909. *Antarctophthirus microchir* (Trouessart and Neumann), Enderlein, *Deutsche Südpolar Expedition,* 10: 511; figs. 176, 177, 183, 184.

1916. *Antarctophthirus microchir* (Trouessart and Neumann), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 183.

1916. *Antarctophthirus microchir* (Trouessart and Neumann), Ferris, *Entomological News,* 27: 370.

1928. *Antarctophthirus microchir* (Trouessart and Neumann), Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee,* Teil XId, pp. 21–23; figs. 17, 18, 19.

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PREVIOUS RECORDS. Recorded by Trouessart and Neumann from *Phocarctos hookeri,* Aukland Island, and by Ferris from *Zalophus californianus,* California.

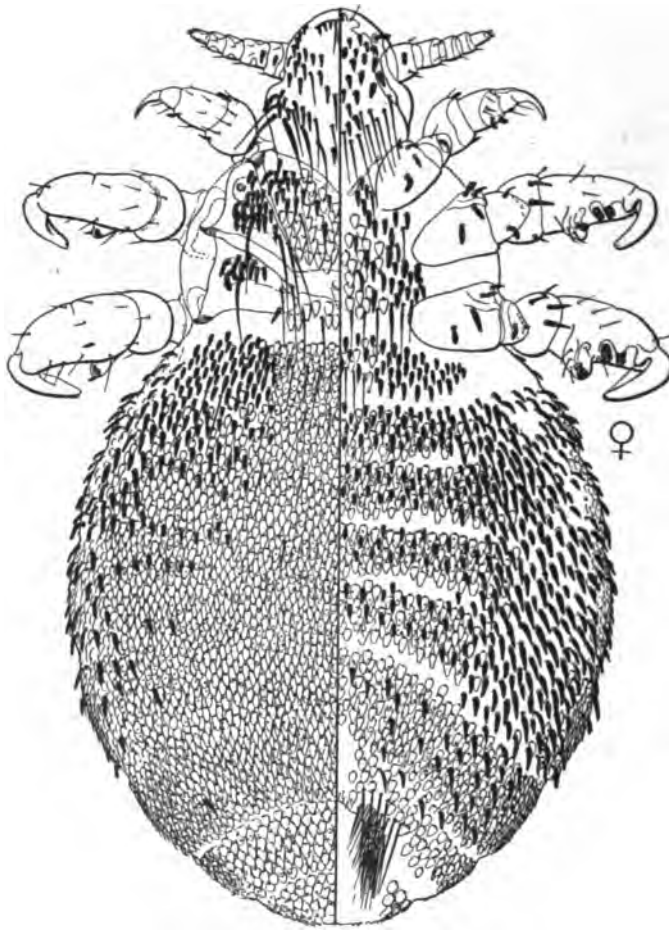

FIG. 285.—*Antarctophthirus microchir* (Trouessart and Neumann), female. From specimen from *Zalophus californianus,* California.

SPECIMENS EXAMINED. Those upon which the record by Ferris was based and others from the Steller sea lion, *Eumetopias jubata,* Año Nuevo Island (Stanford University).

FEMALE (Fig. 285). Length 3.00 mm. A stout-bodied and moderately pigmented form. *Head* with prominent post-antennal angles, but the hind head only slightly constricted and thus without a distinct neck;

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both dorsum and venter with numerous short, thorn-like setae and with a posterior fringe of long setae; antennae presenting no distinctive features.

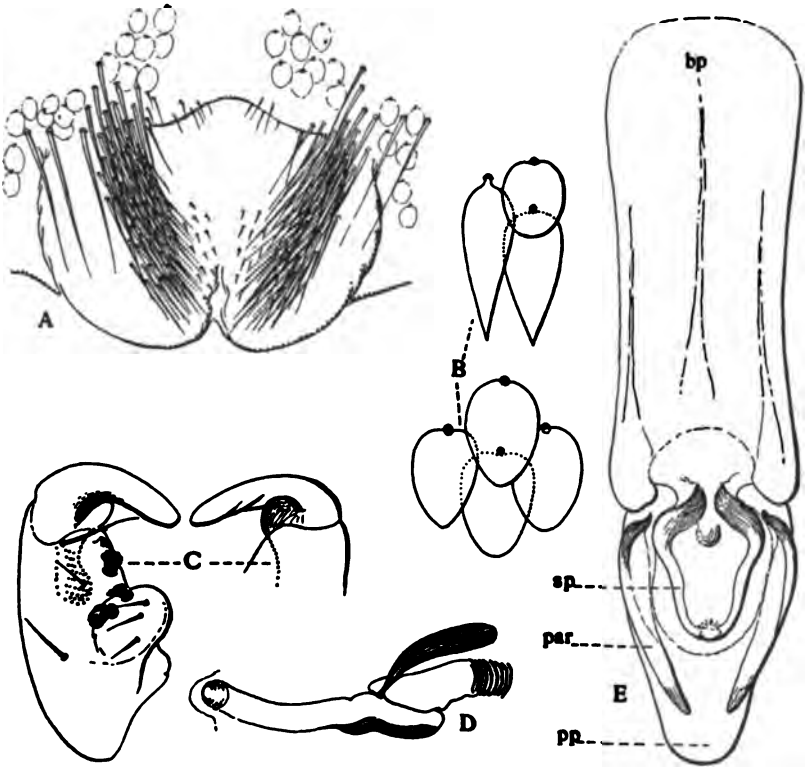

FIG. 286.—*Antarctophthirus microchir* (Trouessart and Neumann): *A*, genital region of female; *B*, types of scales; *C*, middle tibio-tarsus and claw; *D*, abdominal spiracle; *E*, genitalia of male.

Thorax slightly longer than the head and considerably broader, somewhat trapezoidal, the sclerotic areas large, both mesothorax and metathorax dorsally with numerous stout setae laterally and with scales medially; sternal area with numerous stout setae and scales intermingled; legs of the generic type. Mesothoracic spiracle very small.

Abdomen subcircular or very broadly oval, the derm somewhat pigmented, the dorsum very thickly and quite uniformly beset with scales, which toward the lateral margins on the anterior portion of the abdomen are intermingled with flattened, pointed, stout setae. On the ventral side the scales are less numerous and the setae more abundant and

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larger, the latter forming a longitudinal band along each lateral margin and there intermingled with but few scales. The scales are quite uniform in size and shape, being slightly elongate-oval and narrowly rounded at the apex, some of those on the abdomen being longer and more pointed (Fig. 286 *B*).

Genital region (Fig. 286 *A*) with a tuft of long setae at each side of the genital opening.

MALE. Length 2.5 mm. In general closely resembling the female, but with the abdomen more pointed. Genitalia (Fig. 286 *E*) with a relatively very large basal plate (*bp*); parameres (*par*) short, not reaching to the apex of the very large pseudopenis, the arms of which articulate with the bases of the parameres; inclosed within the arms of the pseudopenis is a quite large structure that may be regarded as the statumen penis (*sp*).

NOTES.—The figures given by Enderlein, which were made from specimens from the type lot, are very precise and complete, making the identification of the species certain. The specimens from the two species of California sea lions agree very closely with these figures and with each other.

This species is very similar to *A. ogmorhini* from which it differs in the form of the scales and in not having the occiput constricted into a neck.

4. Antarctophthirus trichechi (Bohemann)

FIGS. 287, 288

1865. *Haematophinus trichechi* Bohemann, *Vetenskaps-Akademie Förhandlingar, Kobnhaven,* 22: 557; pl. 35, fig. 2.

1880. *Haematopinus trichechi* Bohemann, Piaget, *Les Pediculines,* p. 656.

1908. *Haematopinus trichechi* Bohemann, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum,* p. 11.

1909. *Antarctophthirus trichechi* (Bohemann), Neumann, *Archives de Parasitologie,* 13: 532–37; figs. 30, 31.

1909. *Antarctophthirus trichechi* (Bohemann), Enderlein, *Deutsche Südpolar Expedition,* 10: 512–13; figs. 172, 173, 185–88.

1910. *Arctophtirius trichechi* (Bohemann), Mjöberg, *Arkiv för Zoologi,* 6: 13: 178–80; figs. 90–92.

1915. *Antarctophthirus trichechi* (Bohemann), Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals,* Stanford University Publications, University Series, p. 49; t.f. 17*B*; pl. 3, fig. 1.

1916. *Antarctophthirus trichechi* (Bohemann), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 183.

1928. *Antarctophthirus trichechi* (Bohemann), Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee,* Teil XI*d*, pp. 25–30; figs. 24–29.

PREVIOUS RECORDS. Recorded by various writers from *Odobenus* (= *Odobaenus* = *Trichechus*) *rosmarus* from Greenland, Spitzbergen, and adjacent regions, and by Kellogg and Ferris from *O. obesus,* "northeast of Siberia."

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SPECIMENS EXAMINED. Those upon which the foregoing record by Kellogg and Ferris was based and others from "walrus," caught in the Kara Sea (Hamburg Museum).

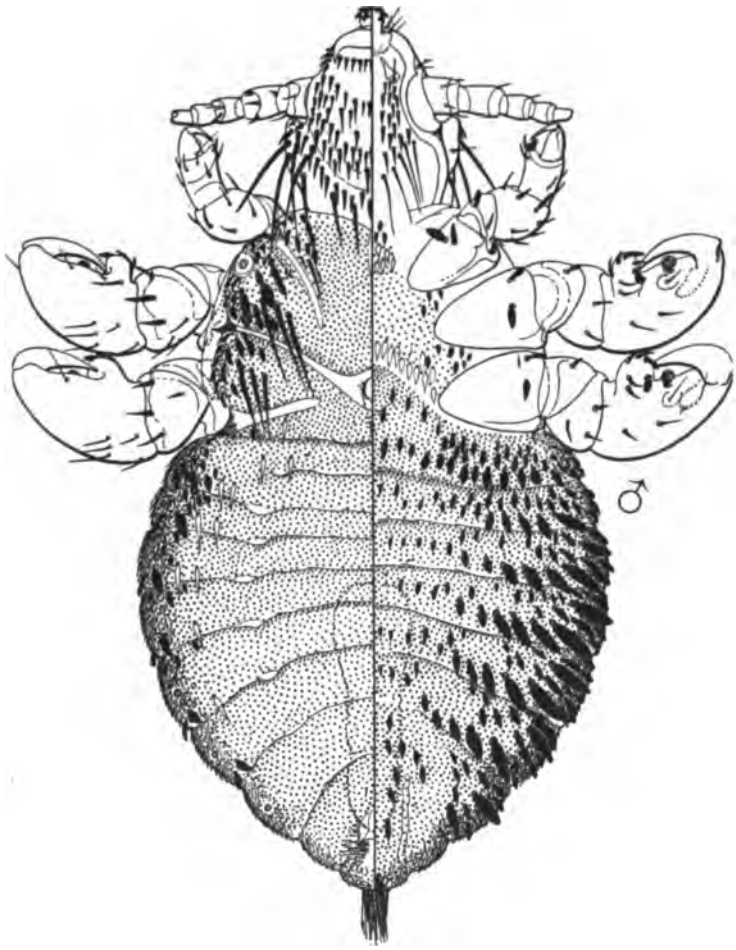

FIG. 287.—*Antarctophthirus trichechi* (Bohemann), male. From specimen from *Odobenus obesus*.

MALE (Fig. 287). Length 2.75 mm. A deeply pigmented species. *Head* relatively large, with prominent post-antennal angles and with the occipital region slightly constricted; anterior margin bordered by a conspicuous sclerotic band and the ventral side with a longitudinal band extending from the anterior margin around the base of the antenna to the occipital border;

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dorsum with numerous, short, acute setae and with a cluster of long setae along the lateral margin of the hind head; ventral side with short setae and with a gular fringe of long setae. Proboscis (Fig. 288 *D*) unusually prominent and with unusually large hooks.

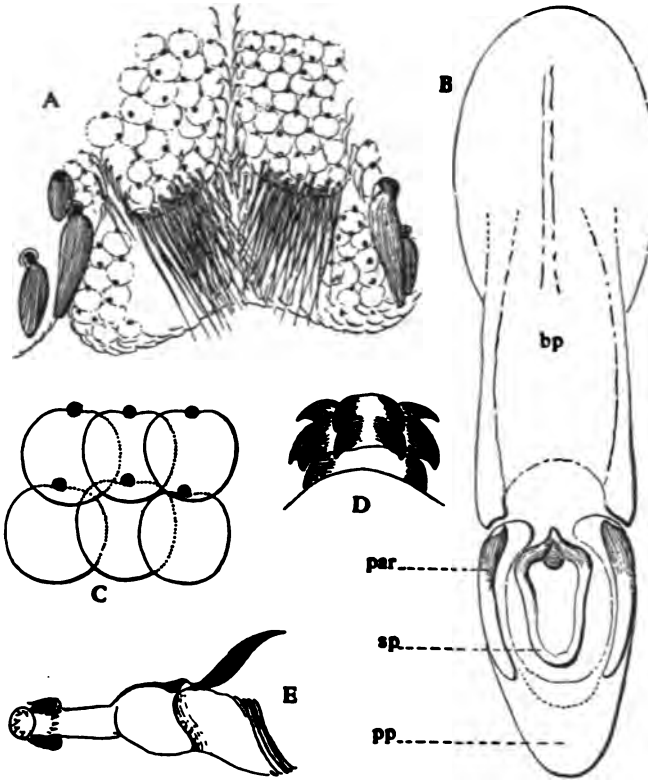

FIG. 288.—*Antarctophthirus trichechi* (Bohemann): *A*, genital region of female; *B*, genitalia of male; *C*, scales; *D*, rostrum; *E*, abdominal spiracle.

Thorax about as long as the head and about one and one-half times as wide, the lateral margins arcuate; dorsum thickly beset with scales and with numerous flattened setae near the lateral margins; sternum with but few short setae and with numerous scales. Legs of the form typical of the genus, exceedingly stout, the mesothoracic and metathoracic claws with but an inconspicuous lobe at the base.

Abdomen slightly pointed, very thickly beset both dorsally and ventrally with scales, with a few lanceolate setae near the lateral margins dorsally and with more and larger setae ventrally. Scales (Fig. 288 *C*) quite uniform in size and shape, slightly cordate, very transparent and scarcely

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visible unless disturbed, but with very conspicuous pedicels. Apex of the abdomen with a tuft of setae. Spiracles (Fig. 288 *E*) small, provided with a specialized closing apparatus. *Genitalia* (Fig. 288 *B*) with a long basal plate (*bp*); parameres (*par*) very small and inconspicuous, much exceeded by the very large V-shaped pseudopenis (*pp*), the arms of which inclose a strongly sclerotic piece that may be regarded as the statumen penis (*sp*). Genital plate consisting of a pair of very small and inconspicuous longitudinal areas.

FEMALE. Length 3.00–4.00 mm. In general very similar to the male, but with the abdomen more nearly circular, the ninth segment forming a small median apical lobe. *Genital region* (Fig. 288 *A*) very small and close to the apex of the abdomen. It is difficult to determine the exact disposition of the parts, but there appear to be two median lobes each bearing a cluster of crowded setae. Whether these lobes represent the vulva or the tufts of setae on the ninth sternite which appear in other species of this group is not determinable in the material at hand, but probably it is the latter.

IMMATURE STAGES. Representatives of the penultimate and possibly one other stage are at hand. These differ from the female significantly only in size.

NOTES.—This species has been utilized by Mjöberg as the type of his genus *Arctophtirius*, but while it departs in some respects from other members of *Antarctophthirus* there seem to be no good grounds for a generic separation.

5. **Antarctophthirus callorhini** (Osborn)

FIGS. 289, 290

1899. *Haematopinus callorhini* Osborn, in *The Fur Seals and Fur-Seal Islands of the North Pacific Ocean*, 3: 553; fig. 1.

1915. *Antarctophthirus monachus* Kellogg and Ferris, *Anoplura and Mallophaga of North American Mammals*, Stanford University Publications, University Series, p. 49; t.f. 17 *B*; pl. 3, fig. 1.

1916. *Antarctophthirus monachus* Kellogg and Ferris, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 183.

1923. *Antarctophthirus callorhini* (Osborn), McAtee, in "Insects, Arachnids and Chilopods of the Pribilof Islands, Alaska," *North American Fauna*, 46: 142.

1928. *Antarctophthirus monachus* Kellogg and Ferris, Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee*, Teil XI*d*, pp. 23–25; figs. 20–23.

PREVIOUS RECORDS. Known only from the original record by Osborn, from *Callorhinus alascanus* (= *ursinus*), Pribilof Islands, Alaska. The specimen, without host or locality data, upon which the description of

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A. monachus Kellogg and Ferris was based, now appears without doubt to have come from this same lot.

SPECIMENS EXAMINED. A male, the type of *A. monachus* Kellogg and Ferris, undoubtedly one of the specimens originally recorded by Osborn; a male and a female and one immature specimen from the type host, Pribilof Islands, 1918, *G. D. Hanna* (all Stanford University).

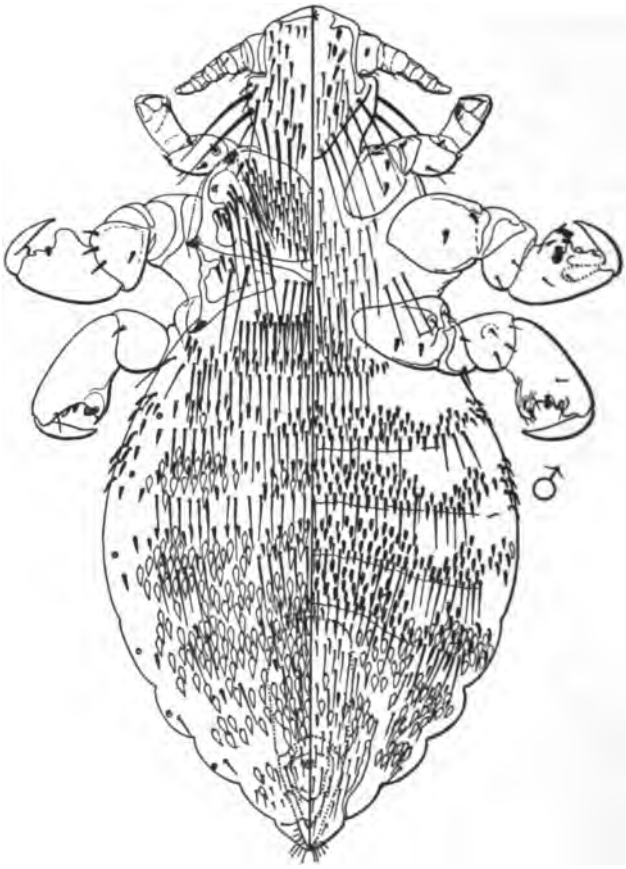

FIG. 289.—*Antarctophthirus callorhini* (Osborn), male.

MALE (Fig. 289). Length 2.5 mm. A comparatively slender-bodied member of this group. *Head* relatively large, with prominent post-antennal angles and a slightly constricted occipital region; dorsally with numerous short setae and a lateral and posterior fringe of long setae; ventral side with small setae of various shapes and a gular fringe of long setae.

Thorax about as long as the head and twice as wide, the lateral margins

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nearly parallel, with many setae of various lengths both dorsally and ventrally, but without scales. Mesothoracic spiracle exceedingly small. Meso- and metathoracic legs very large and stout, the claw with a distinct basal lobe (Fig. 290 *D*).

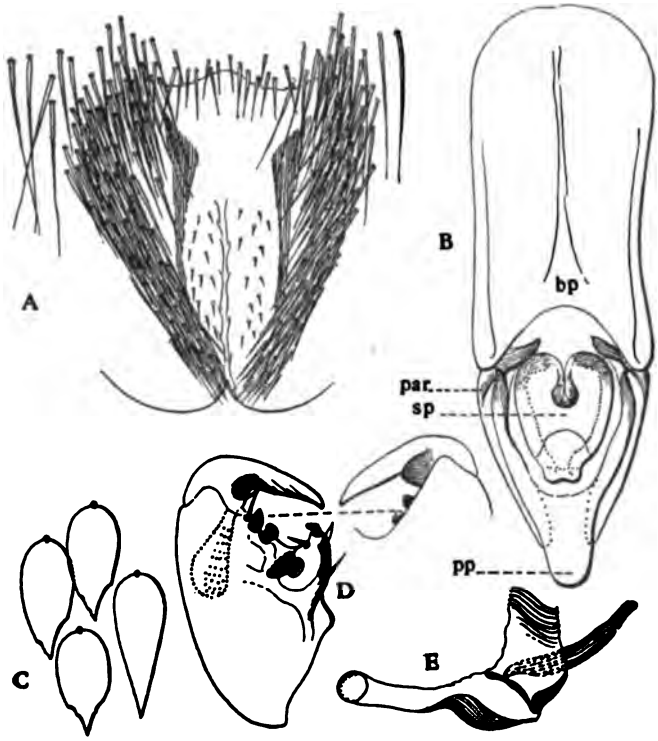

FIG. 290.—*Antarctophthirus callorhini* (Osborn): *A*, genital region of female; *B*, genitalia of male; *C*, types of scales; *D*, middle tibio-tarsus and claw; *E*, abdominal spiracle.

Abdomen elongate and slightly pointed, beset dorsally with setae of various lengths and sizes and particularly in the posterior half with scattered scales; ventral side more thickly beset with setae which are for the most part short and stout and with a few scattered scales in the apical region. Scales (Fig. 290 *C*) somewhat variable in form, but for the most part elongate, pointed, and with irregular serrations near the apex. Spiracles (Fig. 290 *E*) very small, provided with a specialized closing apparatus. *Genitalia* (Fig. 290 *B*) with a short, broad basal plate (*bp*); parameres (*par*) inconspicuous, shorter than the rather elongate and somewhat Y-shaped pseudopenis (*pp*), the arms of which inclose a conspicuous piece that may be regarded as the statumen penis (*sp*).

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FEMALE. Length 3.00 mm. In general very similar to the male. *Genital region* (Fig. 290*A*) with an elongate area of crowded setae on each side on the ninth sternite.

NOTES.—In the paucity of its scales this species departs from the common characteristics of *Antarctophthirus* and in its general appearance suggests *Proechinophthirius fluctus* (Ferris) which occurs on the same host. But there seems to be no good reason for removing it from *Antarctophthirus*.

6. **Antarctophthirus** sp.

SPECIMENS EXAMINED. A fragment of a single specimen, from *Arctocephalus* sp., no data (U.S.N.M. 16463).

NOTES.—This fragmentary specimen seems to represent an undescribed species, with scales somewhat of the type of those of *A. microchir* but more elongate. While it should not be named from such a specimen, its occurrence is worthy of record.

Genus **LEPIDOPHTHIRUS** Enderlein

1904. Enderlein, *Zoologischer Anzeiger*, **28**: 44.
1908. Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 18.
1909. Enderlein, *Deutsche Südpolar Expedition*, **10**: 513.
1916. Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 184.
1928. Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee*, Teil XI*d*, p. 31.
1929. Ewing, *Manual of External Parasites*, p. 148.

Anoplura without eyes; with four-segmented antennae, which are not sexually dimorphic; with the anterior legs relatively small and weak and with slender claw, the posterior and middle legs equal, very large and stout, with stout claw which has a distinct lobe at the base; thorax with the notum reduced to at the most a very slight median furrow and a pit which is inclosed by the mesothoracic phragmata, the sternum not sclerotic; abdomen without tergal and sternal plates; paratergal plates entirely lacking; gonopophyses lacking; entire body very thickly beset with setae of various forms, many flattened and passing into scales with which the dorsum of thorax and abdomen is thickly beset; spiracles present on the mesothorax, but exceedingly small, and on the third to eighth abdominal segments, all provided with a specialized closing apparatus.

HOSTS. Known only from the genus *Macrorhinus*, the southern sea elephants, of the family Phocidae.

TYPE OF THE GENUS. *Lepidophthirus macrorhini* Enderlein, the only included species.

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NOTES.—The single known species of *Lepidophthirus* represents in many respects the ultimate of specialization in the sucking lice. Enderlein has indicated that spiracles are present on the metathorax and second abdominal segment as vestiges, but the writer is unable to agree that such is the case.

1. Lepidophthirus macrorhini Enderlein

FIGS. 291, 292

1904. *Lepidophthirus macrorhini* Enderlein, *Zoologischer Anzeiger*, 28: 46–47; figs. 1–5.
1908. *Lepidophthirus macrorhini* Enderlein, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 18.
1916. *Lepidophthirus macrorhini* Enderlein, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 184.
1928. *Lepidophthirus macrorhini* Enderlein, Freund, "Anoplura Pinnipediorum," in *Die Tierwelt der Nord- und Ostsee*, Teil XId, pp. 32–34; figs. 30–35.
1929. *Lepidophthirus macrorhini* Enderlein, Bedford, *Director of Veterinary Services, Union of South Africa, Report*, 15: 507.

PREVIOUS RECORDS. From the "elephant seal," *Macrorhinus leoninus*, Kerguelen Island (Enderlein), and near Capetown, South Africa (Bedford).

SPECIMENS EXAMINED. A male and a female, received through the kindness of Mr. G. A. H. Bedford and derived from the lot recorded by him.

FEMALE (Fig. 291). Length 3.5 mm. A very stout-bodied form. *Head* short and broad, the hind head forming a narrow lateral lobe and much constricted to form a broad neck; dorsum thickly beset with short setae and with a fringe of long setae along the posterior margin of the hind head; ventral side with a few small, stout setae and with a raised gular region; mouth opening retracted to the ventral side of the head. Antennae (Fig. 292 *C*) clearly four-segmented, without trace of a fifth segment.

Thorax but little longer than the head and more than twice as broad, the lateral margins arcuate, the coxal condyles not connected by longitudinal bars; sternum non-sclerotic except for a piece in the form of an inverted Y, which extends from the posterior point of the head to behind the anterior coxae; sternum beset only with short, flattened setae. Legs presenting no unusual characteristics, the claw of the middle and posterior pairs with a distinct basal lobe.

Abdomen subcircular, very thickly beset dorsally with flattened, lanceolate setae near the lateral margins, these intermingled with and in the median region giving way entirely to scales. The setae and scales are all directed toward a point on the meson of the sixth and seventh segments, which leads to the curious fact that those of the ninth to seventh segments

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are directed forward. In the median region of the dorsum the scales are more heavily pigmented than elsewhere, leading to the formation of two

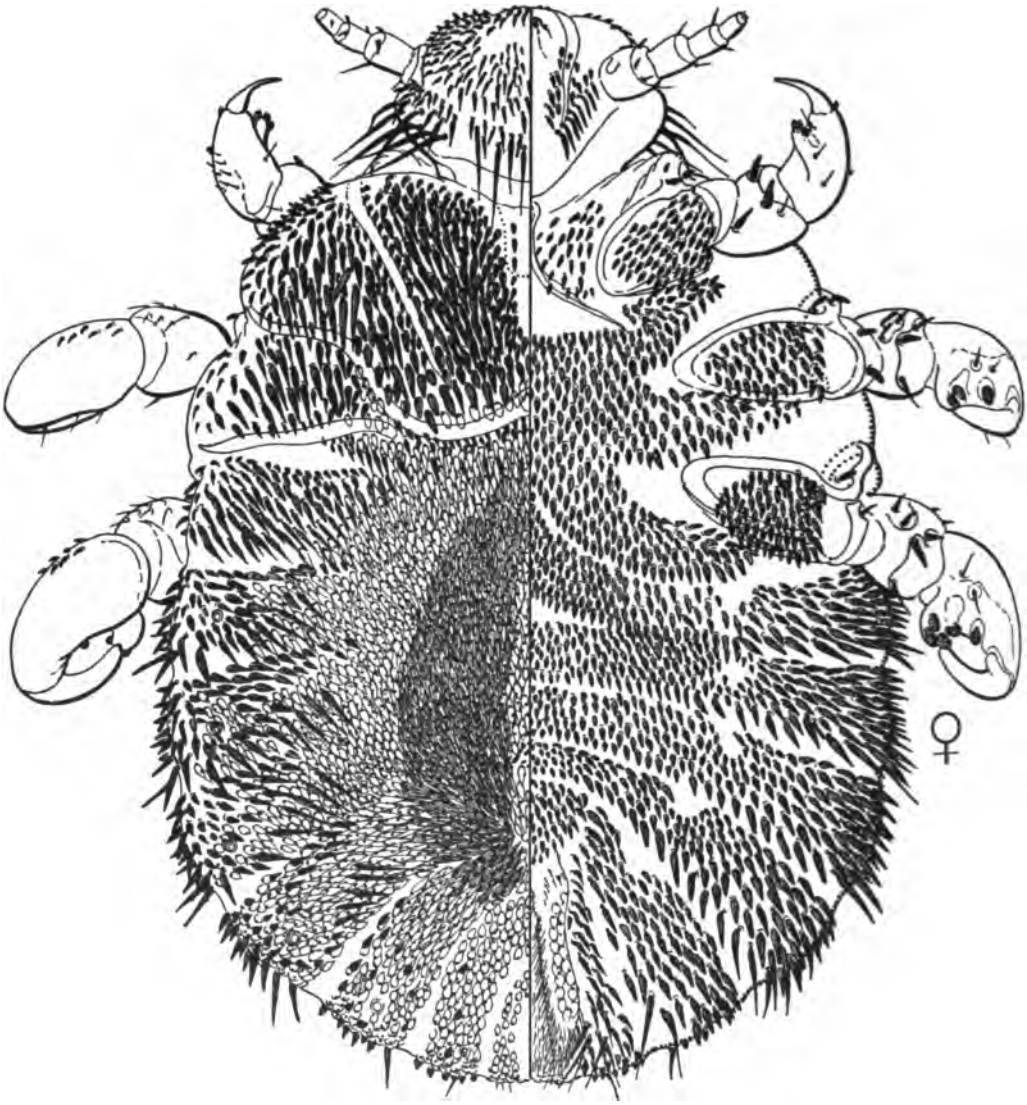

FIG. 291.—*Lepidophthirus macrorhini* Enderlein, female.

dark, longitudinal bands which are conspicuous even to the naked eye. The scales are of varying form and size (Fig. 292 *B*), some being sharply pointed, others slightly emarginate at the apex.

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On the ventral side the scales are for the most part lacking, appearing only in the genital region, and the derm is thickly beset with flattened lanceolate setae of various sizes. *Genital region* (Fig. 292 *A*) of unusual form, there being two elongate and slightly divergent lobes, which are

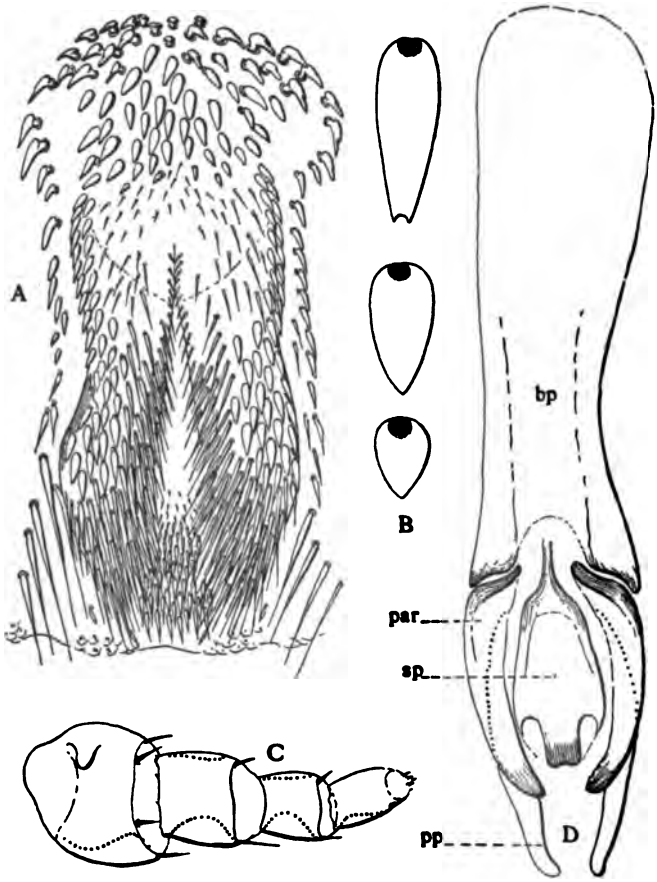

FIG. 292.—*Lepidophthirus macrorhini* Enderlein: *A*, genital region of female; *B*, types of scales; *C*, antenna; *D*, genitalia of male.

thickly beset with setae. These lobes have the appearance of gonopophyses, but, on the basis of comparison with related species, it appears possible that they are merely lobes formed by the vulva. It has not been possible to work out the spiracular closing apparatus.

MALE. Length 3.00 mm. In general very closely resembling the female, but with the dark dorsal bands of the abdomen not so conspicuous.

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Genitalia (Fig. 292 *D*) in general of the type common to the other pinniped-infesting species, the basal plate (*bp*) large and long, the parameres (*par*) rather small, much exceeded by the pseudopenis (*pp*) which in the single specimen at hand appears to be divided into two parts; between the parameres is a large statumen penis (*sp*).

NOTES.—Possibly because of individual variation, the scales on the specimens at hand do not agree entirely with the figure given by Enderlein, being much less truncate or emarginate than indicated by him. There is no reason to question the specific identification, however.

Genus **PEDICINUS** Gervais

1844. *Pedicinus* Gervais, in Walckenaer's *Histoire naturelle des insectes aptères*, 3: 301.
1874. *Pedicinus*, Giebel, *Insecta Epizoa*, p. 32.
1880. *Pedicinus*, Piaget, *Les Pediculines*, p. 630.
1904. *Pedicinus*, Enderlein, *Zoologischer Anzeiger*, 28: 136, 138.
1908. *Pedicinus*, Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 9.
1910. *Pedicinus*, Mjöberg, *Arkiv för Zoologi*, 6: 172.
1912. *Phthirpedicinus* Fahrenholz, *Zoologischer Anzeiger*, 39: 54.
1912. *Pedicinus*, Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover*, 2–4: 12–16.
1912. *Phthirpedicinus*, Fahrenholz, *ibid.*, p. 22.
1913. *Pedicinus*, Patton and Cragg, *Textbook of Medical Entomology*, p. 546.
1916. *Pedicinus*, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 139.
1916. *Phthirpedicinus*, Ferris, *ibid.*, p. 140.
1916. *Neopedicinus* Fahrenholz, *Archiv für Naturgeschichte*, 81 (Abt. A): Fasc. 11: 7.
1929. *Pedicinus*, Ewing, *Manual of External Parasites*, p. 143.
1929. *Neopedicinus*, *ibid.*
1929. *Phthirpedicinus*, *ibid.*
1932. *Pedicinus*, Werneck, *Annaes da Academia Brasileira de Sciencias*, 4: 179–83.

Anoplura with eyes; antennae five-segmented, but frequently—especially in the female—with the last three segments more or less fused, causing a three-segmented appearance; sexually dimorphic by the presence of a short, stout seta on the dorsal side of each of the last three antennal segments; dorsum of the thorax with the pleural ridges uniting at the meson into a sclerotic area which incloses a slit-like median fold or pit which probably represents the vestiges of the true notum; sternal plate lacking; legs of varying form, the anterior pair always slender and with slender claw, the middle and posterior pairs ranging from but little stouter than the first to much stouter and with heavy claws; abdomen always membranous except for the usual sclerotization of the ninth tergite and the genital area; free paratergal plates present on the fourth to sixth or fifth and sixth segments; abdominal setae always very small, arranged in a single

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definite transverse row on each segment both dorsally and ventrally; gonopophyses vestigial, their position indicated chiefly by a row of small setae; genitalia of the male of a distinctive type, the parameres present and well developed, inclosing the pseudopenis between their apices, the penis borne at the apex of a sclerotic tube of varying form, the preputial sac not evident.

HOSTS. Known only from old-world monkeys of the group Cynomorpha.

TYPE OF THE GENUS. *Pedicinus longiceps* Piaget (= *P. eurygaster* of Gervais, not of Burmeister).

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS

NOTE.—Names in italics are synonyms of the name with which they are coupled. The genera *Phthirpedicinus* and *Neopedicinus*, being here regarded as synonyms of *Pedicinus*, all names previously used in them are here recorded as if used in *Pedicinus*.

albidus (Rudow).
    Haematopinus albidus Rudow.
breviceps Piaget.
    Pedicinus eurygaster (Burmeister). (Part.)
    Pedicinus longiceps Piaget. (Part.)
colobi Fahrenholz.
    Pedicinus longiceps Piaget.
eurygaster (Burmeister).
    Pedicinus breviceps Piaget. (Piaget, part; Mjöberg, part; misidentification.)
    Pedicinus eurygaster (Burmeister). (Piaget, part.)
    Pedicinus longiceps Piaget. (Part.)
    Pedicinus microps (Nitzsch).
    Pedicinus piageti Stroebelt.
    Pediculus eurygaster Burmeister.
    Pediculus microps Nitzsch.
    Phthirpedicinus micropilosus Fahrenholz.
    Phthirpedicinus microps (Nitzsch).
eurygaster (Burmeister). (Misidentification.)
    Pedicinus longiceps Piaget. (Part.)
graciliceps Piaget.
    Pedicinus longiceps Piaget.
hamadryas Mjöberg.
longiceps Piaget. (Part.)
    Pedicinus breviceps Piaget. (Part.)
    Pedicinus colobi Fahrenholz.
    Pedicinus eurygaster (Burmeister). (Gervais; Piaget, part; misidentification.)
    Pedicinus graciliceps Piaget.
    Pedicinus parallelicеps Mjöberg.
    Pedicinus parallelicеps var. *colobi* Fahrenholz.
    Pedicinus rhesi Fahrenholz.
    Pedicinus vulgaris Fahrenholz.
microps (Nitzsch).
    Pedicinus eurygaster (Burmeister).

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micropilosus (Fahrenholz).
Pedicinus eurygaster (Burmeister).
obtusus (Rudow).
Haematopinus obtusus Rudow.
paralleliceps Mjöberg.
Pedicinus longiceps Piaget.
paralleliceps var. *colobi* Fahrenholz.
Pedicinus longiceps Piaget.
patas (Fahrenholz).
Neopedicinus patas Fahrenholz.
piageti Stroebelt.
Pedicinus eurygaster (Burmeister).
rhesi Fahrenholz.
Pedicinus longiceps Piaget.
vulgaris Fahrenholz.
Pedicinus longiceps Piaget.

NOTES.—The available material representing the three named genera *Pedicinus, Phthirpedicinus,* and *Neopedicinus* has been very extensive, although it still leaves something to be desired. It has been sufficient at least to permit the clearing away of the more important nomenclatorial problems and a substantial basis for further studies is now available. Fortunately, this material has included specimens not only from captive monkeys but from animals in the wild state as well.

The literature on these monkey-infesting species is beset with errors from its very beginning. The genus *Pedicinus* itself was originally based upon a species which was obviously misidentified. The work of Piaget involved the confusion of two species, even in the same slide preparation, and the identification of them under four different names. Later authors have added to the tangle until there have been established fourteen names for what are here recognized as but five clearly defined species, and three generic names for what is here regarded as but a single genus. These errors have undoubtedly arisen chiefly from the fact that the characters which mark the species are somewhat obscure, that the insects make very unsatisfactory slide preparations, and that authors have seized upon the most trivial of details as bases for their proposed names.

Some question will arise as to the selection of the genotype for *Pedicinus.* As will later be shown, the species identified by Gervais as the *Pediculus eurygaster* of Burmeister and utilized as the type of the new genus *Pedicinus* is obviously misidentified, being in the present writer's opinion the species later described by Piaget as *Pedicinus longiceps.* What, then, is the type of *Pedicinus?* Is it the species which Gervais had at hand or is it the species which he supposed he had? The matter is of nomenclatorial importance, for these two species would in the opinion of some authors belong to different genera, the species described by Burmeister being, in the opinion here adopted, that which has since been utilized as the type of *Phthirpedicinus.*

The International Code of Zoölogical Nomenclature is silent in regard to this problem and no decision of the International Commission covering it has yet been promulgated.

The view is here adopted that the type of the genus *Pedicinus* is properly that species which Gervais actually had before him and upon which he based his genus, not the species which he erroneously supposed that he had. By this procedure no

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change in the application of the name *Pedicinus* will be produced, even if the genus *Phthirpedicinus* be accepted.

Neither *Phthirpedicinus* Fahrenholz nor *Neopedicinus* Fahrenholz is here accepted as valid. The former was named for the reception of species in which the claws of the middle and posterior legs are stout and heavy and but two pairs of paratergites are present. The latter was established for species with claws of this same type but with three pairs of paratergites. *Pedicinus* was thereby restricted to species with all the legs and claws essentially similar and with three pairs of paratergites. It does not appear that anything is to be gained by these divisions. The few known species are all obviously closely related members of a common stock and constitute a well-defined and homogeneous group which expresses nicely the concept of a genus that is adhered to throughout this series of papers.

1. **Pedicinus longiceps** Piaget

FIGS. 293, 294, 295, 296 *D*

1844. *Pedicinus eurygaster* (Burmeister), Gervais, in Walckenaer, *Histoire naturelle des insectes aptères,* **3**: 301; pl. 48, figs. 1, 1*b*. (Misidentification.)
1869. *? Haematopinus obtusus* Rudow, *Zeitschrift für den gesamten Naturwissenschaften,* **23**: 169.
1880. *Pedicinus eurygaster* (Gervais), Piaget, *Les Pediculines,* pp. 630–32; pl. 51, fig. 6. (Part; misidentification.)
1880. *Pedicinus longiceps* Piaget, *ibid.,* p. 632; pl. 51, fig. 7. (Part.)
1880. *Pedicinus breviceps* Piaget, *ibid.,* pp. 632–33; pl. 52, fig. 1. (Part.)
1885. *Pedicinus graciliceps* Piaget, *ibid., Supplement,* pp. 141–42; pl. 15, fig. 2.
1908. *Pedicinus eurygaster* (Gervais) [*sic*], Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum,* p. 9.
1908. *Pedicinus longiceps* Piaget, Dalla Torre, *ibid.,* p. 9.
1910. *Pedicinus paralleliceps* Mjöberg, *Arkiv för Zoologi,* **6**: 174–76; fig. 88.
1910. *Pedicinus breviceps* Piaget, Mjöberg, *ibid.,* p. 172. (Part; misidentification.)
1912. *Pedicinus rhesi* Fahrenholz, *Zoologischer Anzeiger,* **39**: 54.
1912. *Pedicinus rhesi* Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover,* **2–4**: 16–19; pl. 16, figs. 4–9.
1912. *Pedicinus eurygaster* (Burmeister), Fahrenholz, *ibid.,* pp. 14–15. (Part.)
1912. *Pedicinus longiceps* Piaget, Fahrenholz, *ibid.,* p. 15. (Part.)
1912. *Pedicinus breviceps* Piaget, Fahrenholz, *ibid.,* p. 16. (Part.)
1913. *Pedicinus eurygaster* (Burmeister), Patton and Cragg, *Textbook of Medical Entomology,* p. 546; pl. 68, fig. 1.
1916. *Pedicinus breviceps* Piaget, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 139. (Part.)
1916. *Pedicinus eurygaster* (Burmeister), Ferris, *ibid.,* p. 139. (Part.)
1916. *Pedicinus longiceps* Piaget, Ferris, *ibid.,* p. 139. (Part.)
1916. *Pedicinus rhesi* Fahrenholz, Ferris, *ibid.,* p. 140.
1916. *Pedicinus rhesi* Fahrenholz, Fahrenholz, *Archiv für Naturgeschichte,* **81** (Abt. A): Fasc. 11: 5–6, 32; figs. 5–6.
1916. *Pedicinus vulgaris* Fahrenholz, *ibid.,* p. 32.
1916. *Pedicinus obtusus* (Fahrenholz), *ibid.,* p. 33.
1917. *Pedicinus paralleliceps* Mjöberg, Fahrenholz, *Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten,* **34**: Beiheft 2: 3.

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1917. *Pedicinus paralleliceps* var. *colobi* Fahrenholz, *ibid.*, pp. 3, 8.
1932. *Pedicinus eurygaster* (Burmeister), Werneck, *Annaes da Academia Brasileira de Sciencias*, 4: 183; figs.

PREVIOUS RECORDS.[2] Recorded by Gervais, as *Pedicinus eurygaster* (Burm.), from *Guenon, Macacus,* and *Cynocephalus.* By Piaget (part) as

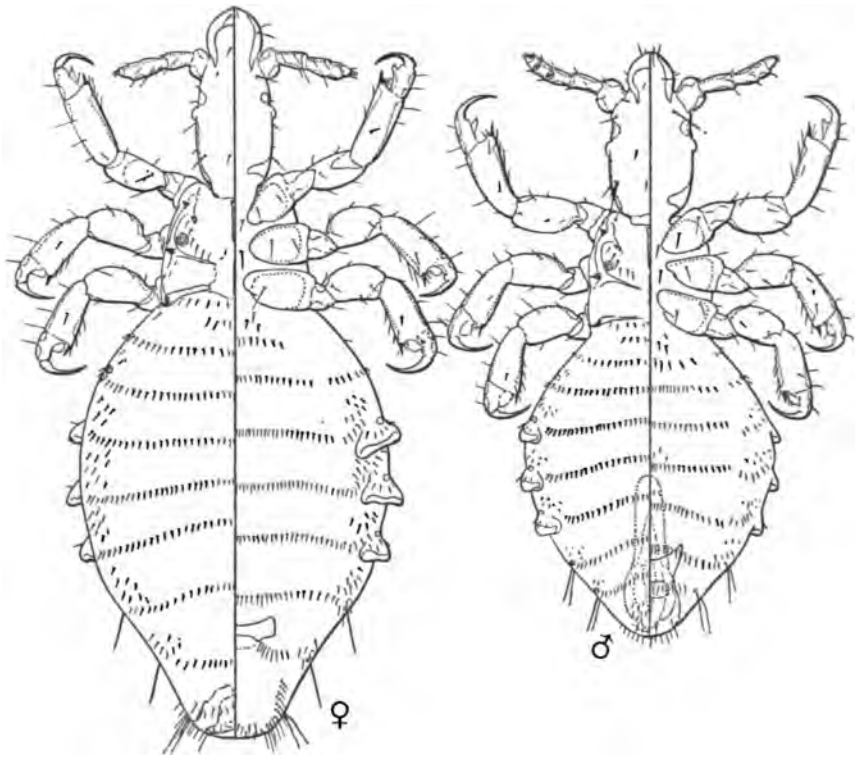

FIG. 293.—*Pedicinus longiceps* Piaget, male and female. From specimens in the Piaget Collection.

P. eurygaster, from *Inuus sinicus, I. nemestrinus,* and *Macacus cynomolgus;* as *P. longiceps* Piaget (part) from *Cercopithecus pruinosus* and

[2] The host names will be cited throughout the discussion of the monkey-infesting species as they have been published or as they occur on the labels of the specimens cited. The nomenclature of the monkeys is in a most extraordinary tangle and probably many of the records involve misidentifications of the hosts or misapplication of names. An attempt will be made to clarify the host nomenclature in connection with the host list which will appear in the final parts of this series. For the nomenclature of the Primates see C. W. Stiles and A. Hassall, "Key Catalogue of Primates for Which Parasites Are Reported," *United States Treasury Department, Public Health Service, Hygienic Laboratory Bulletin No. 152,* 1929.

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Macacus cynomolgus; as *P. breviceps* Piaget (part) from *Cercopithecus mona;* as *P. graciliceps* Piaget from unnamed host. What is possibly this species was recorded by Rudow as *Haematopinus obtusus* from *Semnopithecus maurus.* Recorded by Mjöberg as *P. paralleliceps* Mjöberg from *Macacus silenus* and as *P. breviceps* from *Cercopithecus* sp. Described by Fahrenholz as *P. rhesi* from *Macacus rhesus* and as *P. paralleliceps* var. *colobi* from *Colobus caudatus.* Recorded by Werneck as *P. eurygaster* from *Pithecus rhesus* and from rabbit, *Oryctolagus cuniculus.* Apparently all these records are from specimens taken from hosts in captivity.

SPECIMENS EXAMINED. From the Piaget Collection as follows: From *Semnopithecus pruinosus,* three slides, males, females, and immatures. These may be accepted as co-types of the species and from among them the lecto-holotype should be chosen. Two slides from *"Cercopithecus cynomolchus* (Java)." Two slides labeled *"Pedicinus graciliceps* sur un singe?" which undoubtedly contain the types of this species. A slide of immature specimens labeled *"Pedicinus breviceps* sur un *Cercopithecus mona* (Guinèe)." A slide labeled *"Pedicinus eurygaster* Gerv. sur un *Macacus cynomolgus,"* containing a male and immature specimens of *P. longiceps* in company with a male of the species here regarded as *P. eurygaster;* a slide with the same data containing a female of *eurygaster* and males and females of *longiceps;* four slides with the same data and containing males, females, and immatures of *longiceps.* A slide labeled *"Pedicinus eurygaster* Gervais sur un *Inuus nemestrinus,"* and containing immatures and one adult male.

From the Berlin Museum, three slides determined by Fahrenholz as *Pedicinus rhesi* Fahrenholz, these including a male and a female from *Cynopithecus niger,* Zoölogical Garden, Berlin, and immature specimens from *Cercopithecus griseo-viridis.*

From the Hamburg Museum a slide labeled as from *"Semnopithecus maurus,* A. Poppe det. 1881/2." These are from the type host of Rudow's *Haematopinus obtusus,* and as others of Rudow's supposed types are in the Hamburg Museum it is possible that they are the types of *obtusus.*

Immature specimens from the type lot of *P. paralleliceps* Mjöberg and two females labeled "Typen" of *P. paralleliceps colobi* Fahrenholz have been available through the kindness of the Hamburg Museum.

Other specimens, as follows, have been examined:

Cercopithecus diana, no data (British Museum); *Cercopithecus pygerythraeus,* Rustenberg District, Transvaal, G. A. H. Bedford; *Cercopithecus* sp., Hamburg Zoölogical Garden, 26: XIII: 1911 (Hamburg Museum) and Lagos Laboratories, Nigeria (British Museum).

Macacus arctoides, Zoölogical Garden, Washington (United States National Museum); *Macacus rhesus,* Zoölogical Garden, London (British

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Museum and Molteno Institute); *Macacus speciosus,* Shinano Province, Japan, *S. Nakayama* (Stanford University).

Nasalis larvalis, Kuching, Borneo (British Museum).

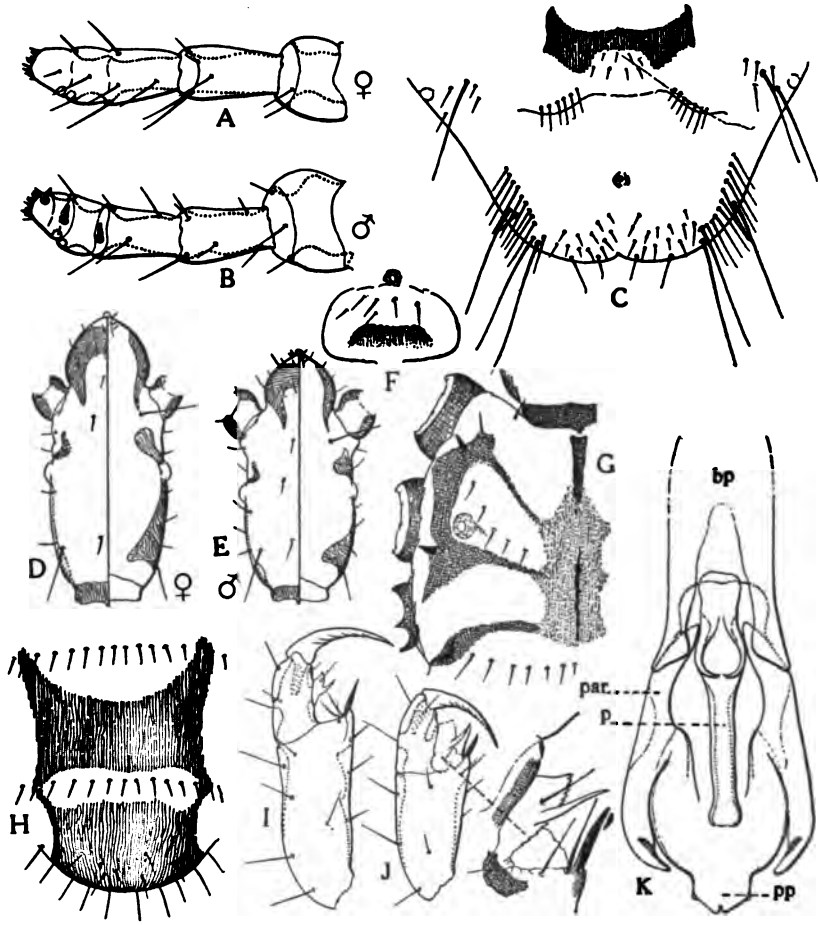

FIG. 294.—*Pedicinus longiceps* Piaget: *A,* antenna of female; *B,* antenna of male; *C,* genital region of female; *D,* head of female; *E,* head of male; *F,* paratergal plate; *G,* portion of dorsum of thorax; *H,* genital plate of male; *I,* anterior tibio-tarsus; *J,* middle or posterior tibio-tarsus, with detail; *K,* genitalia of male.

Pithecus adustus, Telok Besar, Tenasserim (U.S.N.M. 124286); *Pithecus mindanensis,* Mt. Apo, Mindanao, Philippine Islands (U.S.N.M. 125319); *Pithecus mindorus,* Mt. Halcon, Mindoro, Philippine Islands (U.S.N.M. 144675); *Pithecus martini,* London Zoölogical Garden (Brit-

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ish Museum); *Pithecus patas,* no data (British Museum); *Pithecus rhesus,* Kotihar, Kashmir (U.S.N.M. 173812); *Pithecus* sp., Kashmir (U.S.N.M. 63471), West Sumatra (U.S.N.M. 114559), Chance Island, Mergui Archipelago (U.S.N.M. 104439).

Presbytis sanctorum, Sullivan Island, Mergui Archipelago (U.S.N.M. 124113).

Semnopithecus entellus, London Zoölogical Gardens (British Museum).

"Monkey," Alabang, Philippine Islands, *W. B. Mitzmain* (British Museum); Miri, Sarawak (British Museum).

"Java Monkey," Lagos Laboratory, Nigeria (British Museum).

FEMALE (Fig. 293). Length attaining 2.5 mm. *Head* (Fig. 294 *D*) elongate and slender, the fore head sharply rounded; the sclerotic areas forming a curved band across the dorsum of the fore head and longitudinal lateral areas on the hind head; eyes distinct, one faceted; antennae (Fig. 294 *A*) with the last three segments partially fused. *Thorax* with the prothoracic and mesothoracic coxal condyles united by a longitudinal bar (Fig. 294 *G*). *Legs* all with slender claws, the tibio-tarsus of the fore legs (Fig. 294 *I*) longer and relatively more slender than that of the middle and posterior legs (Fig. 294 *J*). *Abdomen* with the setae of the transverse rows numerous and set closely together, the lateral margins both dorsally and ventrally with scattered setae. Paratergal plates present on the fourth to sixth segments, only slightly sclerotic except for a small median area (Fig. 294 *F*). Genital plate (Fig. 294 *C*) very small.

MALE (Fig. 292). Length attaining 1.75 mm. *Head* (Fig. 294 *E*) shorter and stouter than that of the female, the antennae (Fig. 294 *B*) clearly five-segmented. *Abdomen* essentially as in the female. *Genitalia* (Fig. 294 *K*) of a distinctive form, the basal plate (*bp*) about as long as the parameres and deeply bifid posteriorly, the parameres (*par*) acutely pointed and inclosing the rather narrow pseudopenis (*pp*), the penis (*p*) in the form of an elongated tube, slightly expanded at the apex and forming a flat, truncate anterior process between the arms of the basal plate; genital plate (Fig. 294 *H*) quite small.

NOTES.—It is only the opportunity of examining the types of the species described by Piaget, Mjöberg, and Fahrenholz that has made possible the unravelling of the tangle associated with this species, a tangle that has effectually blocked progress in the study of the systematics of this group. To explain the situation it is necessary to go back to the description of *Pediculus eurygaster* Burmeister, the first of the monkey-infesting forms to be named.

While the original description of *Pediculus eurygaster* is very inadequate, it definitely indicates[3] the presence of two pairs of paratergal plates and the name must be applied to a species with this character. Such a species—*and apparently only one such*

[3] ". . . . *spiraculis segmenti quarti et quinti prominentibus fuscis.*"

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—exists and is here recognized under the name of *Pedicinus eurygaster* (Burmeister). It is evident that the species upon which Gervais based the genus *Pedicinus* and which he recorded as the *eurygaster* of Burmeister was misidentified, it being clearly figured as possessing three pairs of paratergal plates. Later authors failed to note this discrepancy and perpetuated the misidentification.

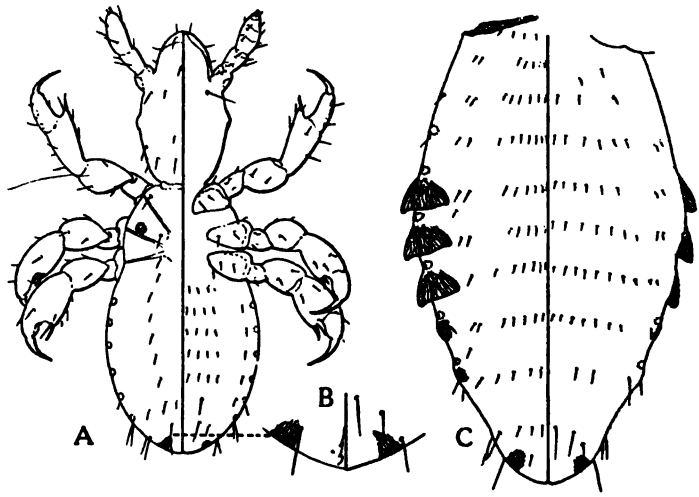

FIG. 295.—*Pedicinus longiceps* Piaget: *A*, first-stage nymph; *B*, detail of apex of abdomen of same; *C*, abdomen of penultimate-stage nymph.

Rudow (1869) complicated the situation by naming two new species from monkeys, both included by him in *Haematopinus*. One of these, *H. albidus*, is here recognized as a valid species and will be dealt with later. The other, *H. obtusus*, from *Semnopithecus maurus*, is undoubtedly a *Pedicinus*. It is possible that the specimens from this host recorded above as received from the Hamburg Museum are the actual types of *obtusus*, for others of Rudow's types are in this museum. If their validity could be established the name *obtusus* would have to be recognized and would replace the name *longiceps* which is here utilized. However, the facts are not established and it seems unreasonable to displace a name, the application of which is definite, on such dubious grounds.

But the greatest complications are those for which Piaget was responsible. His material has been remounted by the writer and put into condition for study. It includes but two species, but these were recorded by Piaget under four specific names, three of which were new. One species, *P. graciliceps* Piaget, was based upon pure material, but each of the others included both actual species, they being included even in the same slide preparations. It appears, furthermore, that Piaget was confused as to the difference between adult and immature specimens and that his figure of *P. breviceps* was based upon the head of one species and the body of another. It remains to the present author, as the first reviser, to select lectotypes which will fix the status of these species. This has been done, keeping in mind the evidence afforded by Piaget's descriptions and records, with the following results:

Pedicinus longiceps, as identified by Piaget, is represented by specimens from *Semnopithecus pruinosus* and *Macacus cynomolgus*. Accepting the hint given by

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Piaget as to the specimens upon which his conclusions were chiefly based, the lectotypes may be chosen from the first lot, and the name will stand on this selection, although this material includes also specimens of what is here considered to be *Pedicinus eurygaster* (Burm.).

Pedicinus graciliceps Piaget, which was described five years later, is identical with *P. longiceps* as here fixed, the supposed differences being nonexistent.

P. longiceps is the common species with three pairs of paratergal plates occurring upon monkeys in zoölogical gardens. It may therefore reasonably be accepted as the species which was erroneously identified by Gervais as the *Pediculus eurygaster* of Burmeister.

However, the complications continue. Fahrenholz, recognizing certain of the facts presented above, although not in possession of material which could clarify the situation, considered that the *Pedicinus eurygaster* of Piaget, based upon the specimens from *Innus nemestrinus,* being a misidentification, was without a name and renamed it *Pedicinus vulgaris.* He also named as new *Pedicinus rhesi,* but himself later placed this as a synonym of *P. paralleliceps* Mjöberg. Further, he named a *P. paralleliceps* var. *colobi.* But all these names, in the opinion here adopted, are synonyms of *P. longiceps* Piaget. Werneck (1932) has recognized some of the facts here enumerated.

In the wide range of material at hand there is naturally a certain amount of variation. There are slight differences in head form and in the proportions of the legs, but there appears to be nothing which offers grounds for specific separation. It is entirely possible that there exist minor strains or races which upon genetical examination would prove to be distinct, but their recognition in preserved material cannot be accomplished.

Immature stages of this species are well represented in the material examined. In the first stage (Fig. 295 *A*) the paratergal plates are entirely lacking and the apex of the abdomen is provided with a pair of small sclerotic spots (Fig. 295 *B*). The antennae have the last three segments closely fused. What are apparently the second and third stages differ from each other only in size. In these the paratergites are well developed, there being three pairs as in the adult, and in addition there is on the seventh and eighth segments a sclerotic spot of variable size accompanying each spiracle (Fig. 295 *C*), together with the apical spots which were present in the first stage. There is some variation in the specimens at hand, some having the spots of the seventh and eighth segments and the abdominal apex more strongly developed.

2. **Pedicinus albidus** (Rudow)

FIG. 296

1869. *Haematopinus albidus* Rudow, *Zeitschrift für die gesamten Naturwissenschaften,* **34**: 168.

1908. *Haematopinus ? albidus* Rudow, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum,* p. 11.

1916. *Haemotopinus ? albidus* Rudow, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 141.

1916. *Pedicinus albidus* (Rudow), Fahrenholz, *Archiv für Naturgeschichte,* **81** (Abt. A): Fasc. 11: 33.

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PREVIOUS RECORDS. Known only from the original record, from the "Barbary ape," *Macaca sylvanus* (= *Simia sylvanus, Macacus inuus*).

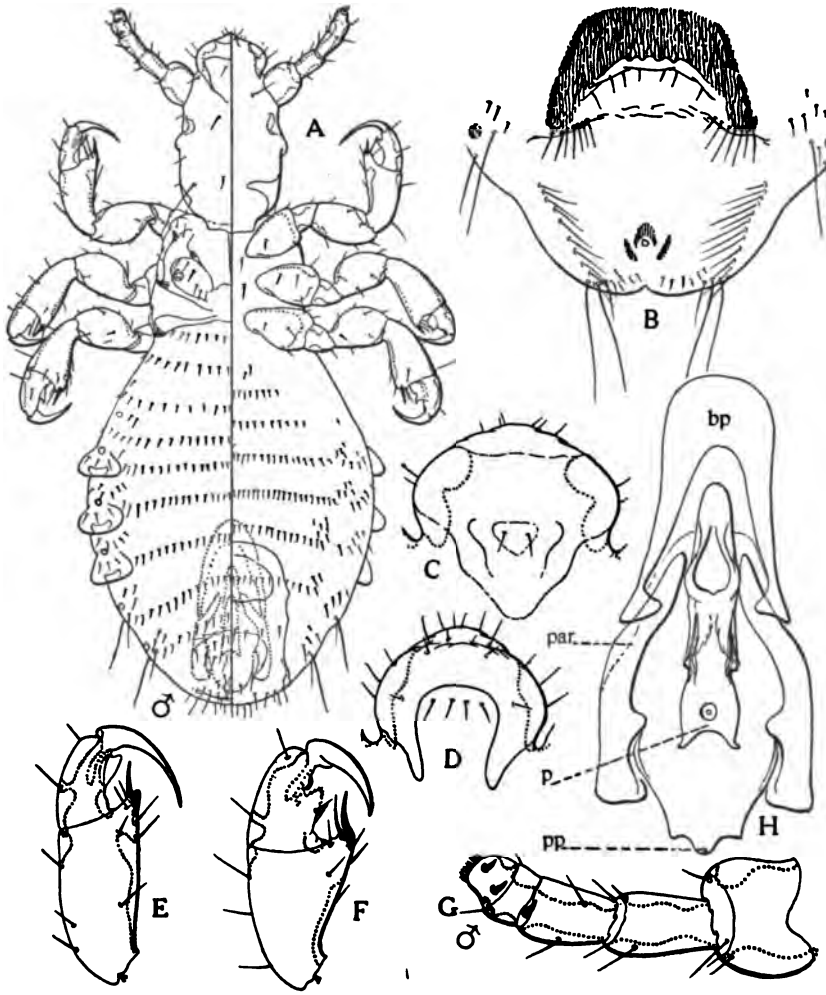

FIG. 296.—*Pedicinus albidus* (Rudow): *A*, male; *B*, genital region of female; *C*, fore head of male; *E*, anterior tibio-tarsus; *F*, middle or posterior tibio-tarsus; *G*, antenna of male; *H*, genitalia of male.
Pedicinus longiceps Piaget: *D*, fore head of male.

SPECIMENS EXAMINED. Several males and females from the type host, London Zoölogical Garden (British Museum) and Morocco (U.S.N.M. 196984).

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FEMALE. In all respects essentially identical with that of *P. longiceps* Piaget, differing chiefly in the form of the genital plate (Fig. 296 *B*), which is constantly much larger and of trapezoidal form with the posterior margin deeply emarginate. Antennae distinctly five-segmented. Legs all with slender claw, the anterior tibio-tarsus (Fig. 296 *E*) but little more slender than the middle and posterior (Fig. 296 *F*).

MALE (Fig. 296 *A*). Essentially similar to the male of *P. longiceps*, from which it differs conspicuously only in the character of the genitalia (Fig. 296 *H*), the penis (*p*) being flattened instead of forming a cylindrical tube as in *P. longiceps*, and the parameres (*par*) having a strong tooth on the mesal margin. The fore head (Fig. 296 *C*) is noticeably shorter and broader than in *P. longiceps* (Fig. 296 *D*). Antennae (Fig. 296 *G*) with the usual modified setae and distinctly five-segmented.

NOTES.—While this species is quite unrecognizable from the original description, its identity may be regarded as reasonably established on the basis of its host, especially as some of the material examined originated from hosts uncontaminated by life in a zoölogical garden. The characters given are constant in the two lots of material taken in different places and at different times, and the species is quite distinct and worthy of recognition.

3. **Pedicinus hamadryas** Mjöberg

FIGS. 297, 298

1910. *Pedicinus hamadryas* Mjöberg, *Arkiv för Zoologi*, 6: 172–74; figs. 86, 87.
1916. *Pedicinus hamadryas* Mjöberg, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 139.
1916. *Pedicinus hamadryas* Mjöberg, Fahrenholz, *Archiv für Naturgeschichte*, 81 (Abt. A): Fasc. 11: 32.

PREVIOUS RECORDS. Known only from the original record by Mjöberg, from *Hamadryas* sp.

SPECIMENS EXAMINED. Males and females from the type lot, received through the kindness of Dr. Von Brun of the Hamburg Museum, and a single specimen in the British Museum labeled merely "louse of monkey, *Pediculus hamadriae*."

FEMALE (Fig. 297). Length attaining 2.75 mm. In general characteristics very similar to *P. longiceps* Piaget, differing tangibly chiefly in the form of the legs. These are very long and slender, with the pigmented areas very sharply defined, the tibio-tarsus of the fore leg (Fig. 298 *A*) being especially slender. The slenderness of the tarsus of the middle and posterior legs (Fig. 298 *B*) is a distinctive feature. The accompanying figures are to the same scale as are the corresponding figures of other

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species. The setae in the transverse abdominal rows seem to be distinctly fewer than in *P. longiceps*.

MALE (Fig. 297). Length 2.00 mm. *Head* shorter and broader than in the female, the first segment of the antennae much larger than in the

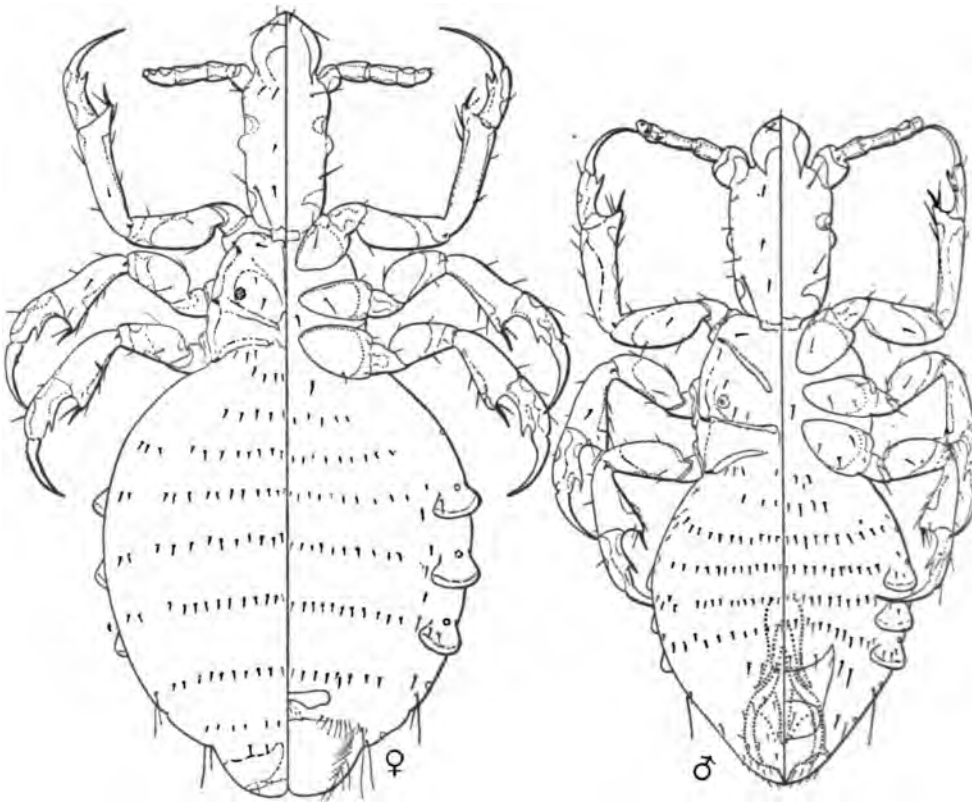

FIG. 297.—*Pedicinus hamadryas* Mjöberg, male and female. From paratypes.

female, the fore head rather strongly constricted. The legs are similar to those of the female. *Genitalia* (Fig. 298 *C*) differing from those of *P. longiceps* in certain details: parameres (*par*) without an acute point at the apex, rather broad and flat; pseudopenis (*pp*) quite small and narrow; penis (*p*) forming a cylindrical tube which is sharply pointed at the apex, its basal prolongation between the arms of the basal plate (*bp*) acute and not truncate as in *P. longiceps*.

NOTE.—While this is very similar to *P. longiceps* it is probably a valid species.

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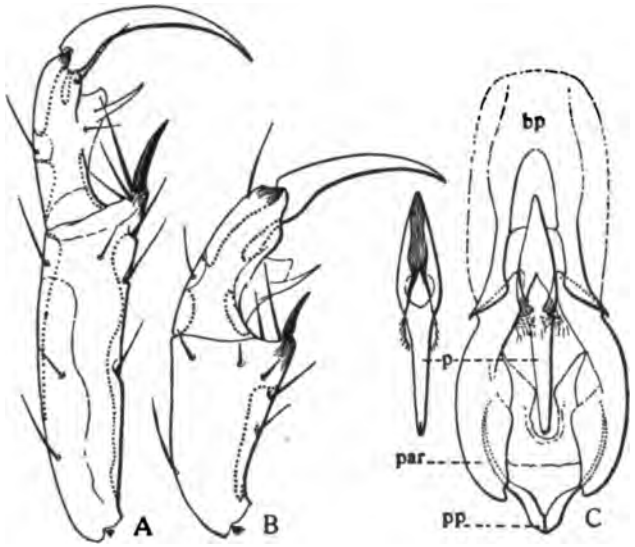

FIG. 298.—*Pedicinus hamadryas* Mjöberg: *A*, anterior tibio-tarsus; *B*, middle or posterior tibio-tarsus; *C*, genitalia of male.

4. **Pedicinus patas** (Fahrenholz)

FIG. 300 *G*

1916. *Neopedicinus patas* Fahrenholz, *Archiv für Naturgeschichte*, **81** (Abt. A: Fasc. 11: 6–7; pl. *f*, fig. 2; t.f. 7.

PREVIOUS RECORDS. Known only from the original record, from *Cercopithecus patas*, without indication of locality. The host, for which the name *Erythrocebus patas* is apparently correct, is a native of West Africa.

SPECIMENS EXAMINED. Several individuals from *Erythrocebus whitei*, Guas Ngishu Plateau, British East Africa (U.S.N.M. 162844); *Lasiopyga kolbi*, Lake Naivasha, British East Africa (U.S.N.M. 162844); *Lasiopyga albogularis kibonotensis*, Taveta, East Africa (U.S.N.M.). On the basis of hosts and the original description by Fahrenholz, I assume these to be this species. Specimens in the British Museum labeled merely "From *Cercopithecus*, Prof. Minchin," represented only by very poor preparations, appear to be the same.

NOTES.—The material at hand, unfortunately, is all in very bad condition, such as to make it impracticable to present complete figures. It is extremely close to the

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next to be described and its distinctive characters will be discussed in connection therewith.

This species has been designated by Fahrenholz as the type of his genus *Neopedicinus*, the genus being based upon the combination of three pairs of paratergites with heavy claws on the middle and posterior legs. This genus is not here regarded as worthy of recognition.

5. **Pedicinus ancoratus** n. sp.

FIGS. 299, 300 *A–F, H, I*

SPECIMENS EXAMINED. Holotype, a male, and allotype and four paratypes from *Presbytis pullata*, Pulo Sebang, East Sumatra (U.S.N.M.

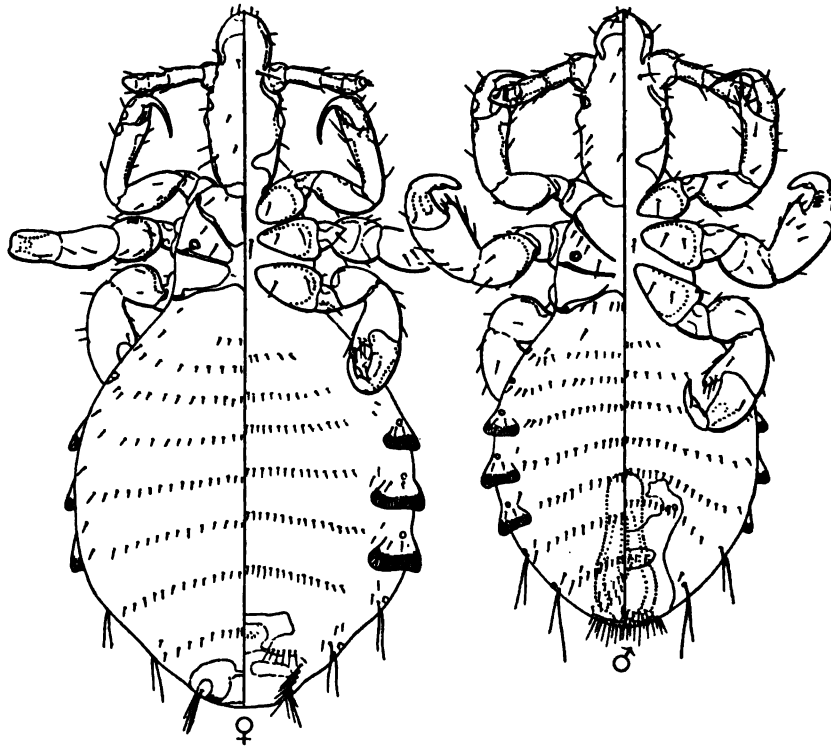

FIG. 299.—*Pedicinus ancoratus* n. sp., male and female. From the types.

123070); numerous paratypes from *Presbytis cristata*, Indragin River, East Sumatra (U.S.N.M. 113170), and Tanjong Ringsam, Banka (U.S.N.M. 124713); *Presbytis germaini mandibularis*, Koh Chang Island, Siam (U.S.N.M. 201549); *Presbytis schistacea*, Lolab, Kashmir (U.S.

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N.M. 63470); *Presbytis rubicunda rubida,* Sukadana, West Borneo (U.S.N.M. 145334); and a single female doubtfully referred to this species, from *Pygathrix priamus,* Ceylon (U.S.N.M. 191986).

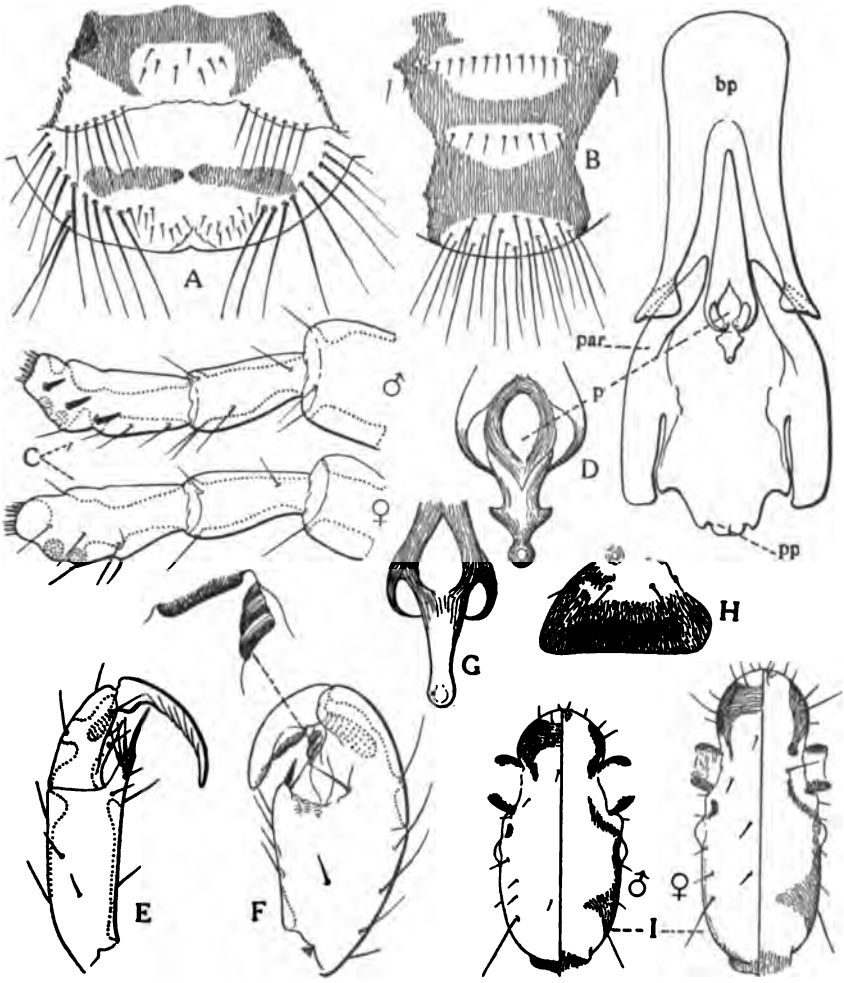

FIG. 300.—*Pedicinus ancoratus* n. sp.: *A,* genital region of female; *B,* genital plate of the male; *C,* antennae of male and female; *D,* genitalia of male with detail of penis; *E,* anterior tibio-tarsus; *F,* middle or posterior tibio-tarsus, with detail; *H,* paratergal plate; *I,* heads of male and female. *Pedicinus patas* Fahrenholz: *G,* detail of penis.

FEMALE (Fig. 299). Length 2.5 mm. *Head* (Fig. 300 *I*) relatively slender, with the antennae set at about the anterior third, the anterior

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margin of the head smoothly rounded, the occiput constricted into a short neck, the markings of the usual type; antennae (Fig. 300 *C*) with the last three segments quite closely fused. *Thorax* of the form characteristic of the genus, the coxal condyles not connected by longitudinal bands; anterior legs with the tibio-tarsus (Fig. 300 *E*) moderately slender and with slender claw; middle and posterior legs (Fig. 300 *F*) with the tibio-tarsus stout and flattened, with stout claw and with a heavily sclerotic area on the inner face of the tarsus, this opposing a similar area on the claw (Fig. 300 *F*, detail).

Abdomen of the ordinary form, the setae rather sparse and without marginal clusters; paratergites present on segments four to six, their posterior half (Fig. 300 *H*) strongly sclerotic; genital plate (Fig. 299 *A*) of a distinctive form as shown.

MALE (Fig. 299). Length 1.75 mm. In general closely resembling the female, but with the head (Fig. 300 *I*) shorter and broader, the antennae (Fig. 300 *C*) of the typical form, with the third and fourth segments quite closely fused. *Genitalia* (Fig. 300 *D*) distinctive by reason of the peculiar form of the penis (*p*) which is strongly produced anteriorly between the arms of the basal plate (*bp*), with its posterior prolongation short, strongly sclerotic, and with distinct lateral points, the form of this suggesting the specific name; parameres (*par*) with their apices truncate and inclosing the broad pseudopenis (*pp*). Genital plate (Fig. 300 *B*) relatively large.

NOTES.—This species is very close to that which is here considered to be *P. patas* (Fahrenholz), the one precise and definite difference being found in the form of the penis. All the specimens at hand from hosts of the genus *Presbytis* agree in having the penis of the form described, while all those which seem to be *P. patas* agree in lacking the lateral processes (Fig. 300 *G*). There are other apparent but slight differences, the specimens of *patas* having the head larger and more slender and apparently lacking the short "neck" which occurs in other species, the head having the appearance of rising from the dorsal aspect of the thorax as noted by Fahrenholz. None of the available specimens of *P. patas* show adequately the form of the genital plate in the female.

Some specimens, including unfortunately but poor preparations of females only, labeled as "found on cats and dogs by hospital assistant, sent by Acting Consul H. A. Attewill, Teng Yack, China, 1911—147," in the British Museum, may be *P. ancoratus*.

6. **Pedicinus pictus** n. sp.

FIGS. 301, 302

MATERIAL EXAMINED. Holotype, a male, and allotype and numerous paratypes from *Colobus caudatus*, Mt. Kenya, British East Africa (U.S.N.M. 163125). Paratypes from the same host and from *Pygathrix*

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entellus, London Zoölogical Gardens (British Museum). The normal host is in all probability *Colobus caudatus*.

FEMALE (Fig. 301). Length 2.00 mm. *Head* (Fig. 302 *E*) with the antennae set at about one-third of the length from the anterior apex, the

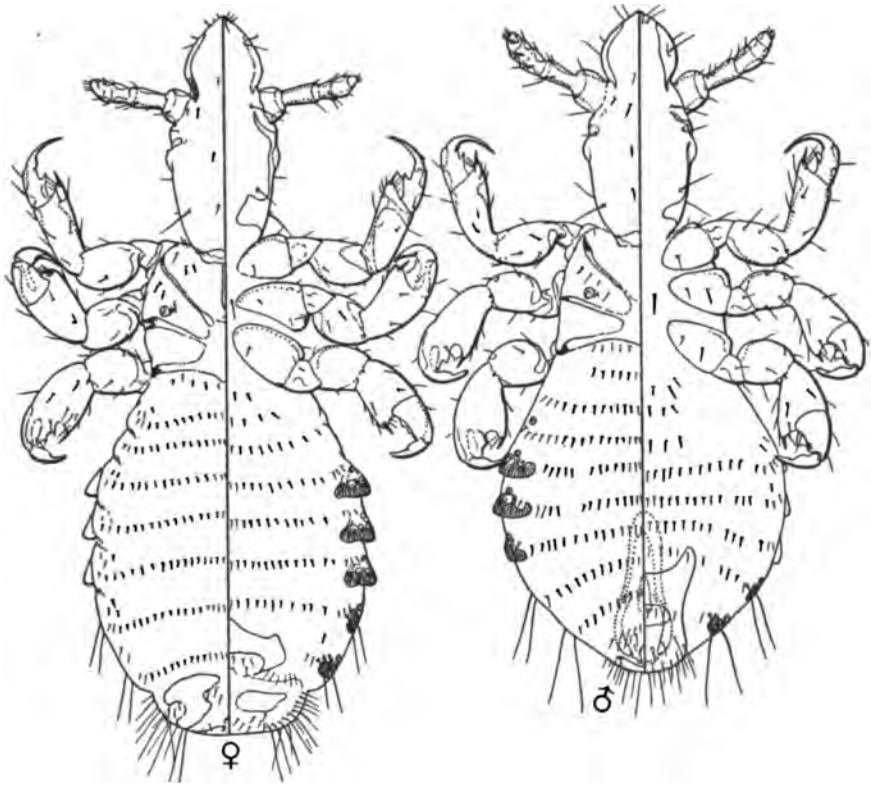

FIG. 301.—*Pedicinus pictus* n. sp. From the types.

eyes slightly behind the middle; fore head sharply parabolic; occiput constricted into a distinct neck; markings those common in the genus; antennae (Fig. 302 *H*) quite distinctly five-segmented. *Thorax* with the pleural ridges uniting into a median sclerotic area, the lateral margins without bands connecting the condyles. Legs short, the tibio-tarsus of the fore leg comparatively slender and with slender claw (Fig. 302 *F*), that of the other legs (Fig. 302 *G*) stout, with stout claw and with two or three sclerotic ridges across the inner face of the tarsus at the base of the claw.

Abdomen rather short and rotund in the specimens at hand, the

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paratergites and the genital plate and dorsal areas of the ninth segment strongly sclerotic and pigmented. Setae arranged in closely set rows. Paratergites with free margins (Fig. 302 *B*) present on the fourth to sixth segments, the seventh to eighth with an irregular sclerotic plate

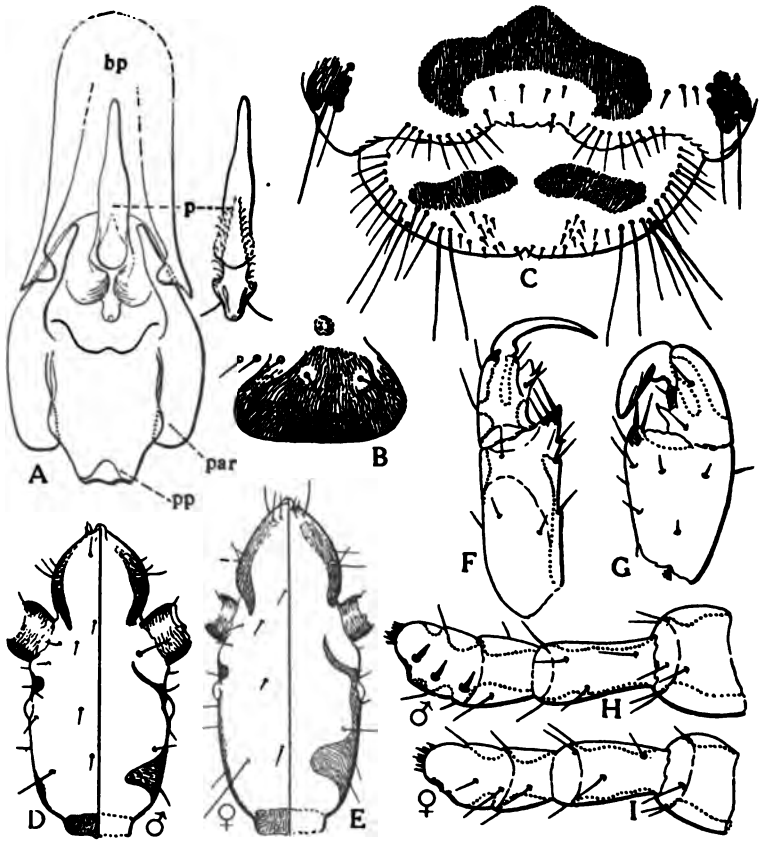

FIG. 302.—*Pedicinus pictus* n. sp.: *A*, genitalia of male; *B*, paratergal plate; *C*, genital region of female; *D*, head of male; *E*, head of female; *F*, anterior tibio-tarsus; *G*, middle or posterior tibio-tarsus; *H*, antenna of male; *I*, antenna of female.

without free margins caudad of the spiracle. Genital plate (Fig. 302 *C*) relatively very large, of a distinctive and constant form; between the gonopophyses and the apex a pair of moderately sclerotic transverse plates.

MALE (Fig. 301). Length 1.75 mm. In general closely resembling the female, the head (Fig. 302 *D*) somewhat shorter and stouter. Antennae (Fig. 302 *H*) with the usual modified setae on the last three

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segments. *Genitalia* (Fig. 302 *A*) distinguished especially by the form of the penis (*p*) which is prolonged anteriorly far up between the arms of the basal plate (*bp*), while its posterior prolongation is exceedingly small; parameres (*par*) blunt tipped, inclosing the rather narrow pseudopenis (*pp*).

NOTES.—This species is evidently quite closely related to *P. patas* (Fahrenholz), being marked chiefly by the paratergal plates of the seventh and eighth segments. The pigmentation of the sclerotic areas is unusually strong for a species of this genus and has suggested the name.

Certain specimens at hand, including a single male from *Colobus kirkii*, no data (U.S.N.M. 16604), and males and females from *Colobus* sp., Zanzibar (Molteno Institute), differ from *P. pictus* in lacking the paratergites of the seventh and eighth segments and in having the head noticeably short. The material, however, is poor and for the present I can do nothing more than place it as near *P. pictus*.

Specimens representing the last immature stage of *P. pictus* are at hand. They apparently lack the paratergites of the seventh and eighth segments and possess a pair of terminal sclerotic areas; otherwise they are very similar to the adults.

7. **Pedicinus eurygaster** (Burmeister)

FIGS. 303, 304, 305

1838. *Pediculus eurygaster* Burmeister, *Genera Insectorum, Rhynchota, Species 21.*
1864. *Pediculus microps* Nitzsch, Giebel, *Zeitschrift für die gesamten Naturwissenschaften*, 23: 32.
1874. *Pedicinus eurygaster* (Burmeister), Giebel, *Insecta Epizoa*, p. 32.
1880. *Pedicinus eurygaster* (Burmeister), Piaget, *Les Pediculines*, p. 630. (Part.)
1880. *Pedicinus longiceps* Piaget, *ibid.*, p. 632. (Part.)
1880. *Pedicinus breviceps* Piaget, *ibid.* (Part.)
1881. *Pedicinus piageti* Stroebelt, *Jahresbericht der zoologischen Section des westfälischen provinzial-Vereins für Wissenschaft und Kunst*, 9: 82; pl. 1, fig. 3.
1908. *Pedicinus eurygaster* Gervais, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 9. (Part.)
1908. *Pedicinus longiceps* Piaget, Dalla Torre, *ibid.* (Part.)
1908. *Pedicinus breviceps* Piaget, Dalla Torre, *ibid.* (Part.)
1910. *Pedicinus breviceps* Piaget, Mjöberg, *Arkiv für Zoologi*, 6: 172. (Part; misidentification.)
1912. *Phthirpedicinus micropilosus* Fahrenholz, *Zoologischer Anzeiger*, 39: 55.
1912. *Phthirpedicinus microps* (Nitzsch), Fahrenholz, *ibid.*
1912. *Phthirpedicinus micropilosus* Fahrenholz, Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover*, 2–4: 23; pl. 1, figs. 1–3.
1912. *Phthirpedicinus microps* (Nitzsch), Fahrenholz, *ibid.*, pp. 25, 28.
1912. *Phthirpedicinus piageti* (Stroebelt), Fahrenholz, *ibid.*, pp. 27, 28.
1916. *Phthirpedicinus micropilosus* Fahrenholz, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 140.
1916. *Pedicinus longiceps* Piaget, Ferris, *ibid.*, p. 139. (Part.)
1916. *Pedicinus breviceps* Piaget, Ferris, *ibid.* (Part.)

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1916. *Pedicinus eurygaster* (Burmeister), Ferris, *ibid.* (Part.)
1916. *Phthirpedicinus microps* (Nitzsch), Ferris, *ibid.*, p. 140.
1916. *Phthirpedicinus piageti* (Stroebelt), Ferris, *ibid.*, p. 141.
1916. *Phthirpedicinus micropilosus* Fahrenholz, Fahrenholz, *Archiv für Naturgeschichte*, 81 (Abt. A): Fasc. 11: 4, 32; t.f. 3–4.
1916. *Phthirpedicinus eurygaster* (Burmeister), Fahrenholz, *ibid.*, p. 32.
1917. *Phthirpedicinus micropilosus* Fahrenholz, Fahrenholz, *Jahrbuch der Hamburgischen wissenschaftlichen Anstalten*, 34: Beiheft 2: 3.

Previous Records. Originally recorded by Burmeister from *Inuus sinicus*. Recorded by Piaget, as *Pedicinus eurygaster* (part), from *Macacus cynomolgus;* as *P. longiceps* (part) from *Cercopithecus cynomolgus;* as *P. breviceps* (part) from *Cercopithecus mona*. Recorded by Stroebelt, as *P. piageti*, from *Macacus erythraeus;* by Mjöberg, as *P. breviceps*, from *Macacus silenus;* by Fahrenholz, as *Phthirpedicinus micropilosus*, from *Macacus rhesus, M. silenus*, and *Cercopithecus* sp. All these records appear to have been from hosts in zoölogical gardens.

Specimens Examined. In the Piaget Collection. Two adult females, labeled as "*Pedicinus breviceps*, sur un *Cercopithecus mona* (Guinèe)." These must be regarded as including the actual type of *breviceps*, other specimens bearing the same data being immatures of what is here regarded as *P. longiceps*. Three females labeled as "*Pedicinus longiceps, Cercopithecus cynomolchus* (Natouna)." One male and one female on different slides, labeled as *P. eurygaster* (Burmeister), mounted with specimens of *P. longiceps*, from "*Macacus cynomolgus*."

Specimens from the Hamburg Museum determined by Fahrenholz as *Phthirpedicinus micropilosus* Fahrenholz, from *Macacus silenus*, Hamburg Zoölogical Garden.

Other specimens as follows: *Macacus rhesus*, London Zoölogical Garden (British Museum); *Pithecus rhesus*, Kotihar, Kashmir (U.S. N.M.); *Macacus fascicularis*, Geneva, 1912, A Ghidini (British Museum); *Pithecus adustus*, Telok Besar, Tenasserim (U.S.N.M. 124286); *Pithecus mindorus*, Mt. Halcon, Philippine Islands (U.S.N.M. 144675); *Pithecus* sp., Chance Island, Mergui Archipelago (U.S.N.M. 10440); *Semnopithecus entellus*, London Zoölogical Garden (British Museum); *Rhinopithecus concolor*, South Pagi Island (U.S.N.M. 121660); *Cynomolgus cynomolgus*, Hamburg Zoölogical Garden (Hamburg Museum); "Martin's *Cercopithecus*" and without indication of host, London Zoölogical Garden (British Museum); "Java monkey," Lagos Laboratory, Nigeria (British Museum).

Female (Fig. 303). Length 1.5 mm. *Head* (Fig. 304 *A*) relatively small, the fore head short and rounded; markings much reduced except for the dorsal band of the fore head; antennae (Fig. 304 *B*) with the last

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three segments fused. *Thorax* (Fig. 304 *H*) without a lateral band uniting the condyles. Anterior legs with the claw (Fig. 304 *D*) slender and the tibio-tarsus relatively so; middle and posterior legs (Fig. 304 *E*) with the tibio-tarsus stout and flattened, the claw stout, the tarsus with three distinct, sclerotic ridges on its inner face (Fig. 304 *E*, detail).

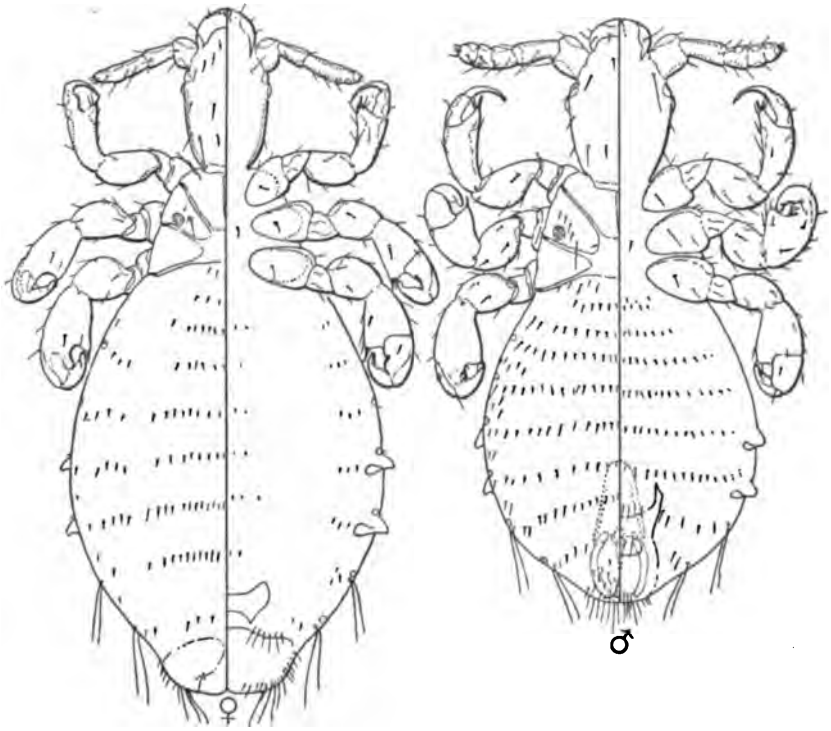

FIG. 303.—*Pedicinus eurygaster* (Burmeister), male and female. From specimens from *"Cynomolgus cynomolgus,"* Hamburg Zoölogical Garden.

Abdomen with the setae very small; paratergites (Fig. 305 *C*) present on only the fifth and sixth segments, small, their outer angle projecting from the abdomen; seventh and eighth segments with from two to four slender marginal setae; genital region (Fig. 304 *C*) with a small median plate.

MALE (Fig. 303). Length 1.2 mm. *Head* (Fig. 304 *A*) somewhat shorter and broader than in the female; antennae (Fig. 304 *B*) with the last three segments distinctly separate and each bearing dorsally a short, stout seta. *Abdomen* as in the female, but blunter at the apex. *Genitalia* (Fig. 304 *G*) of the general form common to the group, the apices of the

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parameres (*par*) widely separated by the broadly divergent arms of the pseudopenis (*pp*), the penis (*p*) in the form of an elongate, conical tube,

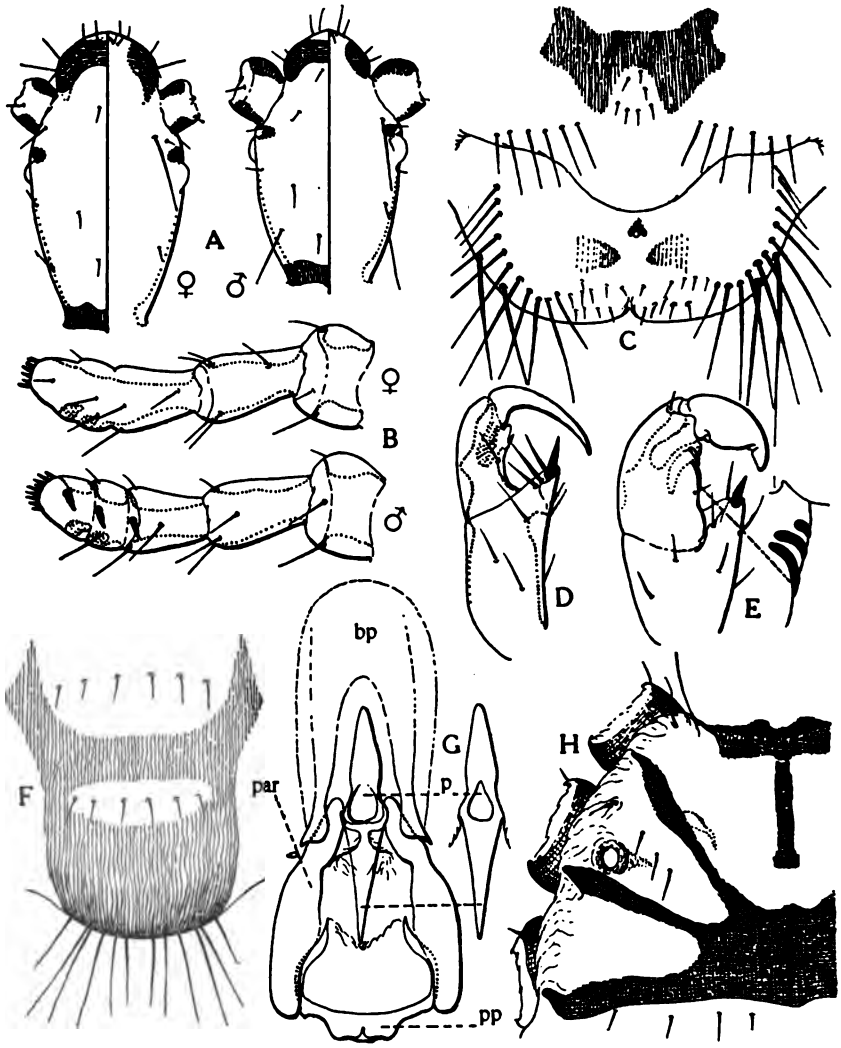

FIG. 304.—*Pedicinus eurygaster* (Burmeister): *A*, heads of male and female; *B*, antennae of male and female; *C*, genital region of female; *D*, anterior tibio-tarsus; *E*, middle or posterior tibio-tarsus, with detail; *F*, genital plate of male; *G*, genitalia of male; *H*, portion of dorsum of thorax.

which is produced as a narrow, flat plate between the arms of the basal plate (*bp*). Genital plate as in Fig. 304 *F*.

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NOTES.—The identification of this species with the *Pediculus eurygaster* of Burmeister rests frankly upon an assumption, but an assumption which seems completely justified. The original description of this species indicates clearly that it possesses but two pairs of paratergites. In all the wide range of material examined in connection with the preparation of this paper there appears but one species which possesses such a character, and this species is evidently very common on various kinds of monkeys in zoölogical gardens. By accepting the view that all the species which have been described as possessing but two pairs of paratergites are identical, no unrecognizable species of this type are left to encumber the literature, while otherwise *P. eurygaster* (Burmeister) and *P. piageti* Stroebelt cannot be disposed of.

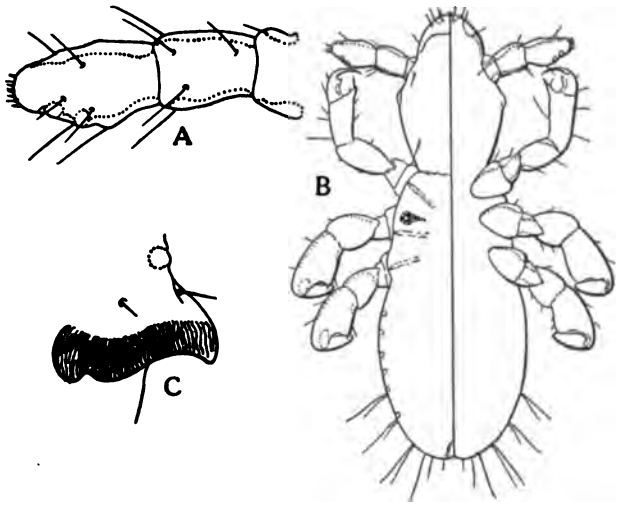

FIG. 305.—*Pedicinus eurygaster* (Burmeister): *A*, antenna of first-stage nymph; *B*, first-stage nymph; *C*, paratergal plate of adult.

As has been pointed out in connection with the description of *P. longiceps* Piaget, the *Pedicinus eurygaster* of authors from Gervais to the time of Fahrenholz is a misidentification. The *Pediculus microps* of Nitzsch, which was resurrected by Fahrenholz with the claim that this name must be recognized, is, upon Fahrenholz' later showing, strictly a synonym of *eurygaster*, the latter having been based by Burmeister upon Nitzsch's notes and figures and the name *microps* having been published long after *eurygaster* had been validated.

Pedicinus piageti Stroebelt is recognizable merely as a species with but two pairs of paratergal plates, and it is upon this basis that it is placed as a synonym of *eurygaster*. *Phthirpedicinus micropilosus* Fahrenholz is sunk on the same basis.

As pointed out in the list of specimens examined, Piaget had this species mounted on the same slides with that here recognized as *P. longiceps* Piaget and labeled with the names *P. eurygaster* (Burmeister), *P. longiceps* Piaget, and *P. breviceps* Piaget. Under the last name were included specimens of what is here considered to be true *eurygaster* and of immature individuals that are considered to be *longiceps*. The original figure of *breviceps* appears to have been compounded from these two species, the head being that of *eurygaster* and the abdomen that of *longiceps*.

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The only possible basis for recognizing more than one species in the material examined is to be found in the fact that in some specimens, notably all those in the Piaget Collection, there are from three to four long marginal setae on the seventh and eighth abdominal segments, while in others there are but two. It does not appear that this offers any reasonable basis for a specific separation.

The immature stages differ but little, except in proportions, from the adult. The apparent first stage is figured (Fig. 305 *B*). The antennae of this stage (Fig. 305 *A*) have the three terminal segments closely fused. There are no marginal sclerotic areas on the abdomen, such as appear in the immature stages of *P. longiceps*. The paratergites appear in what is perhaps the third instar, being then of essentially the same character as in the adult.

Fahrenholz has utilized this species as the type of his genus *Phthirpedicinus*. There seems to be no special reason for separating this genus from *Pedicinus*.

8. **Pedicinus obtusus** (Rudow)

1869. *Haematopinus obtusus* Rudow, *Zeitschrift für die gesamten Naturwissenschaften*, **34**: 169.

1908. *Haematopinus ? obtusus* Rudow, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 11.

1916. *Haematopinus ? obtusus* Rudow, Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 141.

1916. *Pedicinus obtusus* (Rudow), Fahrenholz, *Archiv für Naturgeschichte*, **81** (Abt. A) : Fasc. 11 : 33.

PREVIOUS RECORDS. Known only from the original record by Rudow, from *Semnopithecus maurus*.

NOTES.—This species is utterly unrecognizable from the original description and has been referred to *Pedicinus* solely on the basis of its host.

As has been pointed out in the discussion of *Pedicinus longiceps* Piaget, the writer has examined certain specimens from the type host of *P. obtusus*, belonging to the Hamburg Museum, and it is possible that these are actually Rudow's types, since the supposed types of others of his species are in that museum. But unless it can be shown that such is actually the case, it would seem unjustifiable to suppress a definitely known species in order to recognize anything as vague as is *P. obtusus*. Were we dealing with species rigidly restricted to a single host species and were we certain that the host identification has been correctly made—as is not the case in connection with any of the monkeys—we should be justified in taking such a step, for the probabilities are all in its favor. But there is the possibility that Rudow had some other species, such as *P. eurygaster*, which occurs commonly on various monkeys.

There seems nothing to do at present but to regard *Pedicinus obtusus* (Rudow) as unrecognizable.

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Contributions Toward a Monograph of the Sucking Lice

PART VIII

By

GORDON FLOYD FERRIS

Associate Professor of Zoölogy

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SYSTEMATIC TREATMENT (Cont.)

THE MEANING OF "SPECIES" AS HERE EMPLOYED

We have come finally to the consideration of a group of forms small in numbers but for anthropocentric reasons disproportionately important and presenting a disproportionate share of biological and nomenclatorial problems. These are the lice of man and certain other Primates. In the little genus *Pediculus,* containing, in the opinion here maintained, but three species, all the problems of general biological interest to be found in the study of the sucking lice come sharply to a focus. The proved connection of these insects with the transmission of disease, the problem of their phylogenetic relationships and its connection with that of the relationships of their hosts, the problem of specific differentiation, and the biological meaning of the word "species" all lend a special interest to their study.

It has been the plan of this work, thus far consistently followed, to present first the purely descriptive material which permits the recognition of genera and species, leaving all consideration of the more general biological problems until the end. It seems necessary now to depart somewhat from that plan. In dealing with the genus *Pediculus* we are forced to come definitely to grips with the question of the meaning of the word "species." Because of the peculiar importance of the members of this genus in the transmission of disease, if for no other reason, the problem here has something more than academic importance. And it is here peculiarly difficult, not only because of the actual biological situation involved, but perhaps even more because of the wide variance in the opinions of those who have dealt with it. It has been a highly controversial matter for more than a hundred years and is likely to remain so until there has been a much more extensive substitution of fact for opinion than is even now possible.

In this, as in any controversy, it is important that each participant should make clear his understanding of the meaning of the words that he employs. Otherwise the argument becomes meaningless as well as endless. We must here attempt some answer, admittedly provisional, to the question, "Is there more than one species of the genus *Pediculus* on man, and does this species occur on other Primates?" But to answer that we must first answer the question, "What is meant by the word 'species'?"

To enter into a discussion of the whole problem of the meaning of this word is here impossible. We are concerned only with the meaning that is employed in this paper, and our task is that of making clear what this meaning is and how it is attained.

I have elsewhere pointed out that there are two quite distinct usages of the word "species." The word is employed on the one hand to indicate a

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group of individuals which the systematist, working from preserved material, labels by the same scientific name; and in this case it means little more than that these individuals are sufficiently similar, when examined by the particular methods employed, to make any discrimination among them impracticable. It is evident that such a definition of necessity ignores in most cases a great body of biological fact: range of normal variation, dimorphism or polymorphism, environmental influences, genetic composition, dominants and recessives, genetic recombinations, mutants, these are factors rarely considered in such work. It can at the best represent nothing more than a preliminary sorting, a sorting which in the vast majority of cases is all that is possible, that in many cases is probably correct within tolerable limits, but that cannot afford us a biologically sound interpretation of the word "species." It is a definition based upon purely somatic characters.

As opposed to this, there are those great assemblages of individuals occurring naturally and having a genetic constitution which gives to them something in common not possessed by other assemblages. Such an assemblage, for example, is that which is accepted by geneticists as the species *Drosophila melanogaster,* with its many mutants, some of them differing from the parent form and from each other in such degree that if known only from preserved specimens they would automatically be placed as distinct species. It is evident that in the analysis of such assemblages is to be found the only meaning of the word "species" that has any precise biological significance. And, unfortunately, in most cases it is impossible to accomplish such an analysis, for there are few forms which can be brought into the laboratory and subjected to the necessary experiment.

But it is this significance that we must seek if systematic work is to have any value other than that of a preliminary sorting, if it is not, when its preserved specimens have been placed in cases with labels upon them, to stop short and permit all further study of the problem to pass into other hands. It is this meaning which should be sought especially in the case of such groups as the genus *Pediculus,* where, as has been pointed out, the problem is of more than academic interest and is actually susceptible finally of experimental treatment.

And how are we to frame our formula for the definition of "species"? We may not base it purely upon genetic difference, for even male and female of the same species are genetically different. We may not base it upon genetic fixity, for the black and white phases of the domestic sheep are genetically fixed and if segregated and inbred can be maintained as distinct entities. We may not base it upon absolute refusal to hybridize, for even individuals representing distinct genera have been known to produce fertile offspring when crossed. We may not base it upon genetic purity, for probably such purity rarely, if ever, exists for long in nature.

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Kinsey,[1] recognizing all these difficulties, has defined the word, as understood by him, to mean "a population with a common heredity." The immediately apparent defect of this statement is its failure to define the extent to which the heredity is common. For, after all, all organisms have, to some degree, a common heredity. In some, such as a genetically pure line, this community of heredity is complete, but ranging from this point there is every degree of divergence.

The framing of a formula should really be left to the geneticists, but they in their turn seem no more able to arrive at a precise statement than is anyone else, or perhaps more fully appreciating the difficulties are unwilling to attempt the impossible. It may with much justification be maintained that the word cannot be defined with precision, that it is actually an expression intended, as are so many others, to cover an indefinable concept. But there is little satisfaction in such a point of view, and the systematist confronted with situations which must be defined with some approximation to precision must make an attempt to explain his meaning.

Therefore a formula is offered which seems to cover the meaning here employed and which seems applicable to the conditions that are presented in connection with the species of the genus *Pediculus*.

The word "species" is here employed to indicate a population the members of which form a genetically interlinked complex.

Such a formula covers all the range of normal variation, both germinal and somatic. It allows for forms which may be established as pure lines through isolation but which are still genetically compatible with and will mingle with other members of the complex if the opportunity arises. It allows for any amount of polymorphism. It allows for forms arising through any genetic phenomena such as non-disjunction, crossing-over, and recombination. It allows for the extreme members—aberrations—of the population which are still genetically compatible with the normal members. It allows for all the phenomena commonly lumped under intergradation. It is such a formula as makes it possible to regard all men, or all domestic dogs, or all domestic horses, or all the many mutants of *Drosophila melanogaster* as constituting single species. Each of these groups forms an interlinking genetic complex. The chain—or better, the web—of their genetic connections is unbroken from one extreme to another of their genetic constitution. This is the measure of the degree to which they are possessed of a "common heredity."

It will be immediately evident to the critic that there are difficulties in the way of the application of this formula. What, for example, is to be done

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[1] Alfred C. Kinsey, *The Gall Wasp Genus "Cynips," Indiana University Studies*, 16: 17 (1930).

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with hybrids produced by the crossing of obviously different species? Such situations occur commonly in plants and have been demonstrated in fishes. No discussion of this situation can be offered here. It must be allowed to stand as one of the several difficulties still to be clarified.

The greatest difficulty is that of applying any formula such as our definition of "species" to the scanty evidence which is all that is usually available in the absence of definite experiment. The formula cannot be applied to more than a very small number of species concerning which we have sufficient information to permit conclusions. The best that can be done is to evaluate the probabilities in the light of what is known from the few species that have been sufficiently analyzed or to make use of such experimental evidence as may be available.

Such is the situation in regard to the species of *Pediculus*. One, *P. schäffi* Fahrenholz, is so distinct from any other now known that it presents no problem. One, *P. mjöbergi* Ferris, is not so simple, but the material available indicates a probable solution, although only experimental genetic studies can afford a definite conclusion. One, *P. humanus* Linnaeus, is extraordinarily complex, so much so that in spite of the examination of large quantities of material and in spite of a very considerable amount of experimental work it still remains distinctly clouded. The conclusions here presented are subject to modification by experimental evidence still to be obtained. It is to be hoped that such experimental work may sometime be accomplished. Probably few subjects for experiment can be found which offer greater possibilities for a contribution to the genuine understanding of the problem of species than do the lice of man.

Genus **PEDICULUS** Linnaeus

NOTE.—In the bibliography of this genus only those references are cited which have to do with its nomenclatorial history. References to the two recently named subgenera are segregated at the end of the bibliography.

1758. Linnaeus, *Systema Naturae* (ed. 10), p. 610.
1815. Leach, *Edinburgh Encyclopedia*, **9**: 77.
1817. Leach, *Zoölogical Miscellany*, **3**: 64.
1818. Nitzsch, *Magazin der Entomologie*, **3**: 305.
1838. Burmeister, *Genera Insectorum, Rhynchota.*
1842. Denny, *Monographia Anoplurorum Britanniae*, p. 12.
1864. Nitzsch, *Zeitschrift für die gesamten Naturwissenschaften*, **23**: 21.
1874. Giebel, *Insecta Epizoa*, p. 27.
1880. Piaget, *Les Pediculines*, p. 619.
1905. Enderlein, *Zoologischer Anzeiger*, **28**: 138.
1908. Dalla Torre, "Anoplura," *Wytsman's Genera Insectorum*, p. 8.
1916. Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 136.
1919. Nuttall, *Parasitology*, **11**: 334.

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1920. Nuttall, *ibid.*, 12: 136–153.
1926. Ewing, *Proceedings United States National Museum*, 68: 1–30.
1929. Ewing, *Manual of External Parasites*, p. 143.
1933. Ewing, *Proceedings Biological Society Washington*, 46: 167–174.

Subgenus Parapediculus Ewing

1926. Ewing, *Proceedings United States National Museum*, 68: Article 19, p. 7.
1929. Ewing, *Manual of External Parasites*, p. 143.
1933. Ewing, *Proceedings Biological Society Washington*, 46: 171.

Subgenus Paenipediculus Ewing

1932. Ewing, *Proceedings Biological Society Washington*, 45: 117.
1933. Ewing, *ibid.*, 46: 171.

Anoplura with eyes; with five-segmented antennae which are not sexually dimorphic; legs all of the same character, the claws slender, except that in the male the anterior tibio-tarsus is stouter than the others and the anterior claw slightly toothed; thoracic notum reduced to a median line and a median pit; thoracic sternal plate sclerotized but without free margins; abdomen membranous except for variable tergal sclerotizations in the male, the genital plate, and the paratergites; paratergal plates present on the third to ninth segments, forming a cap over the apices of the laterally lobed segments, their margins not free; abdominal setae, especially in the female, tending to be in part more or less spike-like, their arrangement variable; gonopophyses present, well developed; genitalia of the male of a distinctive type, the parameres apparently greatly reduced and fused with the base of the pseudopenis, the penis forming a sclerotic tube arising from the conspicuous and much-toothed preputial sac; spiracles present on the third to eighth abdominal segments, the first two pairs not displaced toward the meson.

Hosts. Occurring normally on Primates of the families Hominidae (man), Pongidae (the chimpanzees), and Cebidae (the New World monkeys), and possibly on the Hylobatidae (gibbons). Its presence on the gorilla and orang-utan is to be expected.

Type of the Genus. *Pediculus humanus* Linnaeus.

Synonymical List of Names Previously Used in the Genus

Note.—Owing to the fact that the genus *Pediculus* at one time included not only all the sucking lice and all the biting lice as well but also numerous other apterous forms, the list of names which have been used in it and are therefore preoccupied is extremely long. It should be borne in mind by students that under the generally accepted International Rules of Nomenclature none of these names may again be employed in this genus. Consequently a complete list of them is highly desirable. Because of its great length, however, it is, for the convenience of students, divided into three parts: A, names used in the genus as now understood; B, names applying to sucking

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lice other than *Pediculus* as now understood; C, names applying to species which are not sucking lice. In the first two sections names in italics are synonyms of the names in roman with which they are coupled. In the third section all names are synonyms and no attempt has been made to indicate their precise application.

A. Names used in the genus *Pediculus* as now understood:

affinis Mjöberg.
Pediculus mjöbergi Ferris.
albidior von Olfers.
Pediculus humanus Linnaeus.
americanus Ewing.
Pediculus humanus Linnaeus.
angustus Fahrenholz.
Pediculus humanus Linnaeus.
assimilis Fahrenholz.
Pediculus humanus Linnaeus.
atelis Freund.
Pediculus mjöbergi Ferris.
atelophilus Ewing.
Pediculus mjöbergi Ferris.
capitis de Geer.
Pediculus humanus Linnaeus.
cervicalis Latreille.
Pediculus humanus Linnaeus.
chapini Ewing.
Pediculus mjöbergi Ferris.
chinensis Fahrenholz.
Pediculus humanus Linnaeus.
consobrinus Piaget.
Pediculus humanus Linnaeus.
corporis de Geer.
Pediculus humanus Linnaeus.
friedenthali Fahrenholz.
Pediculus humanus Linnaeus.
humanus Linnaeus.
albidior von Olfers.
americanus Ewing.
angustus Fahrenholz.
assimilis Fahrenholz.
capitis de Geer.
cervicalis Latreille.
chinensis Fahrenholz.
consobrinus Piaget.
corporis de Geer.
friedenthali Fahrenholz.
maculatus Fahrenholz.
marginatus Fahrenholz.
nigrescens von Olfers.
nigritarum Fabricius.
oblongus Fahrenholz. (Not of Geoffroy.)

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pubescens von Olfers.
tabescentium Alt.
vestimenti Nitzsch.
lobatus Fahrenholz.
Pediculus mjöbergi Ferris.
maculatus Fahrenholz.
Pediculus humanus Linnaeus.
marginatus Fahrenholz.
Pediculus humanus Linnaeus.
mjöbergi Ferris.
affinis Fahrenholz. (Not of Burmeister.)
atelis Freund.
atelophilus Ewing.
chapini Ewing.
consobrinus Piaget. (Misidentification.)
lobatus Fahrenholz.
nigrescens von Olfers.
Pediculus humanus Linnaeus.
nigritarum Fabricius.
Pediculus humanus Linnaeus.
oblongus Fahrenholz. (Not of Geoffroy.)
Pediculus humanus Linnaeus.
pubescens von Olfers.
Pediculus humanus Linnaeus.
quadrumanus Murray. (Unidentifiable.)
schäffi Fahrenholz.
simiae Ewing.
simiae Ewing.
Pediculus schäffi Fahrenholz.
tabescentium Alt.
Pediculus humanus Linnaeus.
vestimenti Nitzsch.
Pediculus humanus Linnaeus.

B. Sucking lice now referred to genera other than *Pediculus:*

acanthopus Burmeister.
Hoplopleura acanthopus (Burmeister).
affinis Burmeister.
Polyplax affinis (Burmeister).
asini Linnaeus.
Haematopinus asini (Linnaeus).
bufali de Geer.
Haematopinus bufali (de Geer).
bufali-capensis Fabricius.
Haematopinus bufali (de Geer).
bufali-europaei Latreille.
Haematopinus tuberculatus (Burmeister).
cameli Linnaeus.
Microthoracius cameli (Linnaeus).

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canis-familiaris Müller.
Linognathus setosus (von Olfers).
caviae-capensis Pallas. (Actually not a binomial.)
Prolinognathus caviae-capensis (Cummings).
clavicornis Nitzsch. (An unidentifiable species, probably of *Hoplopleura*.)
collaris von Olfers. (Application undetermined.)
crassicornis Nitzsch. (Not of Scopoli.)
Solenopotes burmeisteri (Fahrenholz).
denticulatus Schilling.
A nomen nudum.
eurygaster Burmeister.
Pedicinus eurygaster (Burmeister).
eurygaster Burmeister. (Misidentification.)
Pedicinus longiceps Piaget.
eurysternus Nitzsch.
Haematopinus eurysternus (Nitzsch).
ferus Olafsen. [Application undetermined but in all probability a synonym of *Phthirus pubis* (L.).]
flavidus Nitzsch.
Linognathus setosus (von Olfers).
gracilis Grube.
Hoplopleura hispida (Grube).
hapalinus Gervais.
A nomen nudum.
hirci von Olfers.
A nomen nudum.
hispidus Grube.
Hoplopleura hispida (Grube).
horridus von Olfers.
Echinophthirius horridus (von Olfers).
inguinalis Reichard.
Phthirus pubis (Linnaeus).
isopus Nitzsch.
Linognathus setosus (von Olfers).
laeviusculus Grube.
Neohaematopinus laeviusculus (Grube).
leptocephalus Ehrenberg.
Prolinognathus leptocephalus (Ehrenberg).
leucophaeus Burmeister.
Schizophthirus leucophaeus (Burmeister).
lyriceps Nitzsch.
Haemodipsus lyriocephalus (Burmeister).
lyriocephalus Burmeister.
Haemodipsus lyriocephalus (Burmeister).
macrocephalus Burmeister.
Haematopinus asini (Linnaeus).
microps Nitzsch.
Pedicinus eurygaster (Burmeister).
oxyrhynchus Nitzsch.
Linognathus vituli (Linnaeus).

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phocae Lucas.
Echinophthirius horridus (von Olfers).
phthiriopsis Gervais.
Haematopinus bufali (de Geer).
piliferus Burmeister.
Linognathus setosus (von Olfers).
pleurophaeus Burmeister.
Schizophthirus leucophaeus (Burmeister).
pubis Linnaeus.
Phthirus pubis (Linnaeus).
punctatus Rudow.
Haematopinus tuberculatus (Burmeister).
reclinata Nitzsch.
Polyplax reclinata (Nitzsch).
saccatus Gervais.
Linognathus saccatus (Gervais).
schistopygus Nitzsch.
Linognathus stenopsis (Burmeister).
serratus Burmeister.
Polyplax serrata (Burmeister).
setosus Burmeister. (Not of von Olfers.)
Echinophthirius horridus (von Olfers).
setosus von Olfers. (Not of Burmeister.)
Linognathus setosus (von Olfers).
spermophili Grube.
Neohaematopinus laeviusculus (Grube).
sphaerocephalus Nitzsch. (Not of von Olfers.)
Enderleinellus nitzschi Fahrenholz.
spiculifer Gervais. (An unrecognizable species, probably of *Polyplax*.)
spiniger Burmeister.
Polyplax spinigera (Burmeister).
spinulosus Burmeister.
Polyplax spinulosa (Burmeister).
stenopsis Burmeister.
Linognathus stenopsis (Burmeister).
suis Linnaeus.
Haematopinus suis (Linnaeus).
tenuirostris Burmeister.
Linognathus vituli (Linnaeus).
tuberculatus Burmeister.
Haematopinus tuberculatus (Burmeister).
urius Nitzsch.
Haematopinus suis (Linnaeus).
vituli Linnaeus.
Linognathus vituli (Linnaeus).

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C. Names referring to species which are not sucking lice:[2]

alaudae Schrank.
albiventris Scopoli.
alcae-arcticae Müller.
anatis Fabricius.
andraenae Mikan. (The reference to this has not been seen and its status is uncertain. The name suggests that it is probably a triungulinid.)
anserinus Fabricius.
anseris Linnaeus.
anseris Sulzer.
apis Dragneff. (A triungulin of a Meloid beetle.)
apis Linnaeus. (As figured by Latreille, copied from Sulzer, to whom Linnaeus refers, this is a triungulinid.)
aquaticus Pontoppidan. (Reference not seen and status unknown.)
ardeae Linnaeus.
ardeae-cinereae Fabricius.
ardealis Scopoli.
auritus Scopoli.
bassanae Fabricius.
bassani Müller.
bidentatus Scopoli.
bifurcatus von Olfers.
bovis Linnaeus.
buteonis Fabricius.
calcareus Müller.
caponis Linnaeus.
cerambycinus Scopoli.
cervi Linnaeus.
cervi Linnaeus. [According to Harrison this is the species now called *Trichodectes cervi* (Linnaeus), a Mallophagan. The same name is ascribed also to Linnaeus for *Lipoptena cervi* (Linnaeus), a Hippoboscid fly.]
charadrii Linnaeus.
chelidonius Schrank.
chloridis Schrank.
chloropodis Schrank.
ciconiae Linnaeus.
circi de Fourcroy.
citrinellae Schrank.
clangulae Fabricius.
coarctatus Scopoli.
coccineus Scopoli. (Probably a mite.)
collurionis Schrank.
columbae Linnaeus.
colymbi-grylle Müller.
colymbinus Scopoli.

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[2] Except where otherwise indicated these names refer to Mallophaga. For a list indicating their synonymy and disposition within that group, see Harrison, "The Genera and Species of Mallophaga," *Parasitology*, 9: 10–20 (1916).

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cornicis Fabricius.
corvi Linnaeus.
crassicornis Scopoli.
cuculi Fabricius.
curuccae Schrank.
curvirostrae Schrank.
cuspidatus Scopoli.
cygni Linnaeus.
dentatus Scopoli.
diomedeae Fabricius.
dolichocephalus Scopoli.
emberizae de Geer.
equi Linnaeus.
farionis Linnaeus. (Apparently a crustacean.)
fasciatus Scopoli.
fringillae Scopoli.
fulicae Linnaeus.
fulicae Schrank.
gallinae Linnaeus.
gallipavonis Geoffroy.
gruis Linnaeus.
grylle Fabricius.
gryllotalpae Fabricius.
haematopi Fabricius.
haematopodis Fabricius.
haematopus Scopoli.
hiaticulae Fabricius.
hiaticulae Müller.
hirci-jumoris Scopoli.
hirundinis Fabricius.
infausti Linnaeus. (Apparently a species of the insect order Corrodentia.)
junceus Scopoli.
lagopi Linnaeus.
lagopodis Fabricius.
lanii Fabricius.
lari Fabricius.
lari Müller.
maximus Scopoli.
meleagridis Linnaeus.
meleagridis Panzer.
melis Fabricius.
mergi Fabricius.
mergi Guèrin.
moschatae Linnaeus.
motacillae Fabricius.
murinus Ljungh. (Status not known to the writer.)
musculi Schrank. (Possibly a mite.)
mustelae Schrank.
oblongus Geoffroy.
ocellatus Scopoli.

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opilionis Müller. (Status not known to the writer.)
orioli Fabricius.
ortygometrae Schrank.
ovalis Scopoli.
ovis Linnaeus.
ovis-arietis Schrank.
pari Linnaeus.
pari-palustris Schrank.
passeris de Fourcroy.
pavonis Linnaeus.
phasiani Fabricius.
picae Linnaeus.
pici Fabricius.
pici Schrank.
pilosus Scopoli.
piloti Daldorf. (Status not known to the writer.)
plataleae Linnaeus.
porcelli Linnaeus.
procellariae Fabricius.
pulsatorius de Fourcroy.
pyrrhulae Schrank.
querquedulae Linnaeus.
ralli Scopoli.
ramalium Müller.
recurvirostrae Linnaeus.
ricinoides Linnaeus. (Apparently the so-called "jigger flea" or something similar.)
rostratus Scopoli. (Probably an immature mite.)
rubeculae Schrank.
saviae Schrank.
scolopacisphaeopodis Schrank.
sphaerocephalus von Olfers.
sternae Linnaeus.
strigis Fabricius.
strigis Müller.
strigis O. Fabricius.
strigis Scopoli.
sturni Schrank.
subflavescens Geoffroy.
tantali Fabricius.
tauri Linnaeus.
tauri von Olfers.
tetraonis Linnaeus.
tinnunculi Guèrin.
tinnunculi Linnaeus.
totani Schrank.
tringae Fabricius.
tringaestriatae Müller.
upupae Schrank.
urogalli Schrank.
vagelli Fabricius.

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vespertilionis Linnaeus. (Belonging to the family Nycteiibiidae of the Diptera.)
vulturis Fabricius.

NOTES.—As is apparent from the foregoing lists, the genus *Pediculus* of Linnaeus and even of later authors was a strange assemblage, utilized for almost anything that could be called a "louse." With the segregation of the genus *Ricinus* by de Geer in 1778 for the reception of what are now known as the Mallophaga, the biting lice, the process of reducing *Pediculus* to include merely the sucking lice began. It then remained as the container for all the sucking lice until Leach named the two genera *Phthirus* for the "crab louse" of man and *Haematopinus* for all the other species except only *Pediculus humanus*. As late as 1869, however, Rudow persisted in referring to it a species now regarded as belonging to *Haematopinus*, although other authors had accepted its restriction to the lice of man.

Between two hundred and two hundred and twenty names have therefore been used in the genus. As it is now understood it contains about thirty names, these having been variously employed for what are here recognized as three valid species.

Ewing has named two subgenera of *Pediculus—Parapediculus* for the lice of New World monkeys and *Paenipediculus* for the louse of the chimpanzee. These subgenera are not here accepted. The reasons for rejecting them will be discussed in connection with the consideration of their type species.

Since it appears to be established beyond doubt that a species of *Pediculus* occurs normally on the chimpanzee, it is to be expected that one will be found on the gorilla and another on the orangutan, and should it finally be proved that the gibbons actually possess a species of their own we may expect the full complement of the genus to be six species. The extraordinarily interesting problems of distribution and relationship of these species can be more intelligently discussed when these species are known than they can on the basis of the fragmentary evidence now available.

This genus has long stood as the type of a family, the Pediculidae, which was progressively restricted until it came finally to include only the eye-possessing lice of the Primates included in the three genera, *Pediculus, Phthirus,* and *Pedicinus*. And then, recently, it has again been restricted by Ewing to include only *Pediculus* and *Pedicinus*. The problems connected with the general classification of the Anoplura will be considered in a separate paper and will not be discussed here.

1. Pediculus humanus Linnaeus

PLATES I–III; FIGS. 306–327

NOTE.—Owing to the special interest attached to this species as a parasite of man, a very extensive literature has developed concerning it. References may be found in special scientific papers, in general textbooks of entomology and parasitology, in medical literature, in travelers' and explorers' accounts of the life and habits of primitive peoples, and even in at least two popular novels and the poetry of Robert Burns. Most of these references have no value from the point of view of a strictly systematic study and are disregarded here. A selected bibliography of references which trace the nomenclatorial history of the species since its official establishment by Linnaeus, or which present information pertinent to the systematic problems involved, is presented. In order to make this bibliography more useful, annotations of the references are included.

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1758. *Pediculus humanus* Linnaeus, *Systema Naturae* (ed. 10), p. 610. (The original description of the species, containing no indication that the head and body lice were considered to represent varieties.)

1761. *Pediculus humanus* Linnaeus, Linnaeus, *Fauna Suecica*, p. 475. (The beginning of the controversy concerning the two varieties. "Qui in vestimentis victitat ab eo, qui in capite vivit, non differt ut species, sed tantum varietas.")

1767. *Pediculus humanus* Linnaeus, Linnaeus, *Systema Naturae* (ed. 12), p. 1016. (The two supposed varieties are designated as 1 and 2, respectively, for the head louse and the body louse and characterized thus: "Varietas Capitis durior, coloratior; Vestimentorum laxior, magis cinerea.")

1778. *Pediculus humanus* Linnaeus, de Geer, *Mémoires pour servir à l'histoire des insectes*, 7: 67; pl. 1, figs. 6, 7. [Here the terms *"capitis"* and *"corporis"* are first employed. "Il y a donc une différence palpable entre ces deux sortes de poux, et qui semble indiquer qu'ils sont d'espèce differente, à moins qu'on ne veuille plutôt, comme a fait M. de Linné, les regarder comme deux variétés. Quoiqu'il en soit, on pourroit les distinguer par les dénominations suivantes: (1) *Pediculus (humanus capitis)* cinereus, thorace abdomineque fascia interrupta nigra marginatis; (2) *Pediculus* (*humanus corporis*) albidus, totus immaculatus."]

1783. *Pediculus humanus* Linnaeus, var. α *capitis* and β *corporis*, Retzius, *Caroli de Geer Genera et Species Insectorum, ex generosissimi auctoris Scriptis extraxit, digessit, latine quoad Partem reddidit et Terminologiam Insectorum Linneanam addidit*, p. 201. (Possibly to be regarded as the actual place and date of validation of the names *"capitis"* and *"corporis."*)

1803. *Pediculus humanus* Linnaeus, Latreille, in *Nouveau dictionnaire d'histoire naturelle*, 18: 403. (This reference not seen. According to Nuttall, the name *"humanus"* is here definitely restricted to "le pou du corps," which would constitute the first type fixation.)

1803. *Pediculus cervicalis* Latreille, *ibid.*, 18: 403. (This reference according to Nuttall. The name is indicated as applying to "le pou de tête.")

1805. *Pediculus nigritarum* Fabricius, *Systema Antliatorum*, p. 340. (Established for lice having their "habitat in nigritarum corpore.")

1816. *Pediculus nigrescens* von Olfers, *De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius*, Part 1, p. 81. (According to Fahrenholz, the only writer on the Anoplura who has seen this rare publication.)

1816. *Pediculus albidior* von Olfers, *ibid.*, Part 1, p. 81. (According to Fahrenholz, merely a new name for the body louse.)

1816. *Pediculus pubescens* von Olfers, *ibid.*, Part 1, p. 81. (According to Fahrenholz, merely a new name for the head louse.)

1818. *Pediculus vestimenti* Nitzsch, *Germar's Magazin der Entomologie*, 3: 305. (A new name for the body louse.)

1824. *Pediculus tabescentium* Alt, *De Phthiriasi*, p. 7. (Apparently merely a new name for the body louse.)

1838. *Pediculus capitis* de Geer, Burmeister, *Genera Insectorum, Rhynchota*, Ord. I, Trib. 1, Fam. 1, Species 1.

1838. *Pediculus vestimenti* Nitzsch, Burmeister, *ibid.*, Species 2.

1842. *Pediculus capitis* de Geer, Denny, *Monographia Anoplurorum Britanniae*, p. 19; pl. 26, fig. 2.

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1842. *Pediculus vestimenti* Nitzsch, Denny, *ibid.*, p. 16; pl. 26, fig. 1.
1874. *Pediculus vestimenti* Nitzsch, Giebel, *Insecta Episoa*, p. 27; pl. 1, fig. 5.
1874. *Pediculus capitis* (author?), Giebel, *ibid.*, p. 30; pl. 1, figs. 1, 2.
1880. *Pediculus capitis* Leach (*sic*), Piaget, *Les Pediculines*, p. 619; pl. 51, fig. 2.
1880. *Pediculus vestimenti* Leach (*sic*), Piaget, *ibid.*, p. 623; pl. 51, fig. 3.
1880. *Pediculus consobrinus* Piaget, *ibid.*, p. 626; pl. 51, fig. 4. (Doubtfully described as new.)
1891. *Pediculus humanis* Linnaeus, Meinert, *Entomologiske Meddelelser*, **3**: 58–83; pl. 1. (Concerned mostly with the structure of the mouth parts, but the question whether or not the *Pediculi* of man constitute a single species is considered and it is concluded that there is but one.)
1905. *Pediculus capitis* de Geer and *Pediculus vestimenti* Nitzsch, Cholodkovsky, *Zoologischer Anzeiger*, **28**: 368–370. (Maintains distinctness of the two species on the basis of differences in the eggs.)
1908. *Pediculus capitis* de Geer and *Pediculus corporis* de Geer, Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 8. (Lists, with an exceedingly meager bibliography.)
1911. *Pediculus capitis* de Geer and *Pediculus capitis vestimenti* Nitzsch, Neumann, *Archives de Parasitologie*, **14**: 410–413. (Neumann concludes that the body louse is but a variety of the head louse and assigns to it, contrary to all rules of nomenclature, the name combination given above. He concludes also that *Pediculus consobrinus* Piaget is identical with *Pediculus capitis*.)
1912. *Pediculus capitis* de Geer and *Pediculus corporis* de Geer, Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover*, **2–4**: 2–12; text figs. 1–7; pl. 2, figs. 16–19, and pl. 3, figs. 1–4. (Maintains the distinctness of head and body lice.)
1915. *Pediculus corporis nigritarum* Fabricius, Fahrenholz, *Zeitschrift für Morphologie und Anthropologie*, **17**: 596–597; text fig. 1. (Assumes to recognize this form on the basis of a single specimen.)
1915. *Pediculus capitis angustus*, Fahrenholz, *ibid.*, p. 597; text fig. 2; pl. 21, fig. 1. (From Japanese.)
1915. *Pediculus capitis maculatus*, Fahrenholz, *ibid.*, p. 598; text figs. 3, 4; pl. 21, figs. 2, 3. (For the head louse of African Negroes.)
1915. *Pediculus corporis marginatus*, Fahrenholz, *ibid.*, p. 599. (The body louse of Japanese.)
1916. *Pediculus humanus* Linnaeus, Fahrenholz, *Zoologischer Anzeiger*, **47**: 269–271. (Points out the proper application of the name "*humanus*," and gives data on literature.)
1916. *Pediculus humanus* Linnaeus, Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, **81**: 11: 1, 15.
1916. *Pediculus capitis* de Geer, Fahrenholz, *ibid.*, pp. 1, 15.
1916. *Pediculus friedenthali*, Fahrenholz, *ibid.*, p. 2; text figs. 1, 2; pl., fig. 1. (For a louse from *Hylobates mülleri*. Date of issue indicated as July.)
1916. *Pediculus oblongus*, Fahrenholz, *ibid.*, p. 15; text fig. 14. (For a louse from *Hylobates syndactylus*. Not *Pediculus oblongus* Geoffroy.)
1916. *Pediculus humanus marginatus*, Fahrenholz, *Zoologischer Anzeiger*, **48**: 87. (This was apparently intended as a preliminary diagnosis to appear before the description in the reference cited above, which, however, has priority. Date of issue indicated as October.)
1916. *Pediculus corporis angustus*, Fahrenholz, *ibid.*, p. 88. (The same note applies.)

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1916. *Pediculus capitis maculatus,* Fahrenholz, *Zoologischer Anzeiger,* **48**: 88. (The same note applies.)

1916. *Pediculus friedenthali,* Fahrenholz, *ibid.,* p. 88. (The same note applies. The intended later description of this species apparently has priority of three months.)

1916. *Pediculus oblongus,* Fahrenholz, *ibid.,* p. 88. (The same note as for the next preceding species applies.)

1916. *Pediculus humanus chinensis,* Fahrenholz, *ibid.,* p. 87. (Preliminary description of the body louse of Chinese.)

1917. *Pediculus humanus chinensis* Fahrenholz, Fahrenholz, *Mitteilungen aus dem zoologischen Museum zu Hamburg* (*Beiheft zum Jahrbuch der Hamburgischen Wissenschaftlichen Anstalten* [2]), **34**: 2, 6; text fig. 1. (Definitive description.)

1917. *Pediculus capitis maculatus* Fahrenholz, Fahrenholz, *ibid.,* p. 2. (Records this form from Negroes in Dutch Guiana.)

1917. *Pediculus humanus* Linnaeus, Nuttall, *Parasitology,* **10**: 1–79. (An extensive bibliography is presented.)

1919. *Pediculus assimilis,* Fahrenholz, *Jahresbericht des Niedersächsischen zoologischen Vereins zu Hannover,* **5–10**: 27. (New name for *P. oblongus,* which was preoccupied.)

1919. *Pediculus humanus* Linnaeus, Nuttall, *Parasitology,* **11**: 329–345. (Systematic position, synonymy, and iconography. All the species of *Pediculus* thus far described are regarded as being probably synonyms of *humanus.*)

1919. *Pediculus humanus* Linnaeus, Nuttall, *ibid.,* pp. 279–328; 27 text figs.; pls. 12–17. (Records of abnormalities, together with consideration of hybridism between *"capitis"* and *"corporis"* and other evidence that they constitute but races of a single species.)

1920. *Pediculus humanus* Linnaeus, Nuttall, *ibid.,* **12**: 136–153. (On Fahrenholz' purported new species, subspecies, and varieties of *Pediculus.* A scathing and well-justified criticism, in which it is, however, erroneously concluded that all the named forms of *Pediculus* belong to the same species.)

1924. *Pediculus capitis* de Geer and *Pediculus vestimenti* Nitzsch, Freund, *Tierärztliches Archiv,* Prag, **4** (A) : 42; text figs. 1–4. (Revives the idea of the specific distinctness of head and body lice and presents evidence intended to support this view.)

1925. *Pediculus capitis* de Geer and *Pediculus vestimenti* Nitzsch, Freund, *Deutsche Medizinische Wochenschrift,* Nr. 9: 1–3. (Further evidence intended to prove the distinctness of these two species.)

1926. *Pediculus (Pediculus) humanus nigritarum* Fabricius, Ewing, *Proceedings United States National Museum,* **68**: Article 19, page 16; text figs. 1 *C,* 2, 3 *C,* 5, 6; pl. 2, figs. 6, 7. (Revived for lice from Negroes.)

1926. *Pediculus (Pediculus) humanus corporus* (*sic*) de Geer, Ewing, *ibid.,* p. 18.

1926. *Pediculus (Pediculus) humanus angustus* Fahrenholz, Ewing, *ibid.,* p. 19. (While assuming to recognize this form on the basis of two specimens, the author unites with it *P. capitis marginatus* Fahr. and *P. humanus chinensis* Fahr.)

1926. *Pediculus (Pediculus) humanus americanus,* Ewing, *ibid.,* p. 20; text figs. 1 *B,* 2, 3 *B;* pl. 3, figs. 9, 10, 11. (Established for lice from the heads of Peruvian mummies.)

1926. *Pediculus (Pediculus) humanus humanus* Linnaeus, Ewing, *ibid.,* p. 22. (Ignoring the earlier fixation of the name, the author attempts to establish the head louse as the typical form.)

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1927. *Pediculus capitis* de Geer and *Pediculus corporis* de Geer, Freund, *Medizinische Klinik,* No. 16: 1–3; 2 text figs. (Further evidence derived from the genitalic region of the males, purporting to distinguish the two species.)

1929. *Pediculus humanus humanus* Linnaeus, Ewing, *A Manual of External Parasites,* p. 144; fig. 78.

1929. *Pediculus humanus nigritarum* Fabricius, Ewing, *ibid.,* p. 144; fig. 81.

1929. *Pediculus humanus americanus* Ewing, Ewing, *ibid.,* p. 145; fig. 82.

1930. *Pediculus humanus* Linnaeus, Nuttall and Keilin, *Parasitology, 22*: 1–8; pls. 1–18. (Iconographic studies, with explanatory text. The colored lithographs of the male, female, and first stage, by Terzi, are incomparably the best illustrations of the species ever published.)

1930. *Pediculus humanus humanus* Linnaeus, Bequaert, in the *African Republic of Liberia and the Belgian Congo,* 2: 994. (Head lice of Negroes.)

1930. *Pediculus humanus corporis* de Geer, Bequaert, *ibid.,* p. 995. (Body lice of Negroes.)

1933. *Pediculus humanus americanus* Ewing, Bequaert, *Carnegie Institution of Washington, Publication No. 431,* p. 573. (From Maya Indians, Yucatán and Guatemala.)

Previous Records. Innumerable records, from every race of man in every part of the world. Occasionally taken from other Primates in zoölogical gardens and described by new names—*P. friedenthali* Fahr. and *P. assimilis* Fahr. from gibbons, and *P. consobrinus* Piaget from *Ateles,* one of the New World monkeys. Recorded occasionally from domestic animals, but without evidence that it can live on such hosts.

Specimens Examined. A very large amount of critical material has been available, the greater part of which belongs to the very extensive collection built up by Professor G. H. F. Nuttall in the course of his extended studies and which has very generously been lent to me for study. Because of the length of the list it will be well to break it up into sections, emphasizing especially the more important material.

1. *Typical material of the head louse of Europeans.*—Nuttall, No. 282, from head of woman, Cambridge, England; Nuttall, No. 290, from woman, workhouse, Gloucester, England.

2. *Typical material of the body louse of Europeans.*—Nuttall, No. 252, man's clothes, Cambridge, England; Nuttall, No. 311, from tramp's shirt, workhouse, Cambridge, England.

3. *Lice of Negroes.*—From the Hamburg Museum, specimens identified by Fahrenholz as his *P. capitis maculatus,* from Negroes, Paramaribo, Dutch Guiana. From Wanyaruanda Negroes, Lulenga, Belgian Congo, received from Dr. J. Bequaert and being part of the material recorded by him in 1930. Nuttall, No. 3, from head of Negress, Obuasi, South Ashanti; Nuttall, No. 225, off natives and their clothes, Kibondo, Belgian Congo; Nuttall, No. 230, from Sudanese woman's head, Khartoum, and No. 231, from Arab woman's head, same locality; Nuttall, No. 236, from Negroes,

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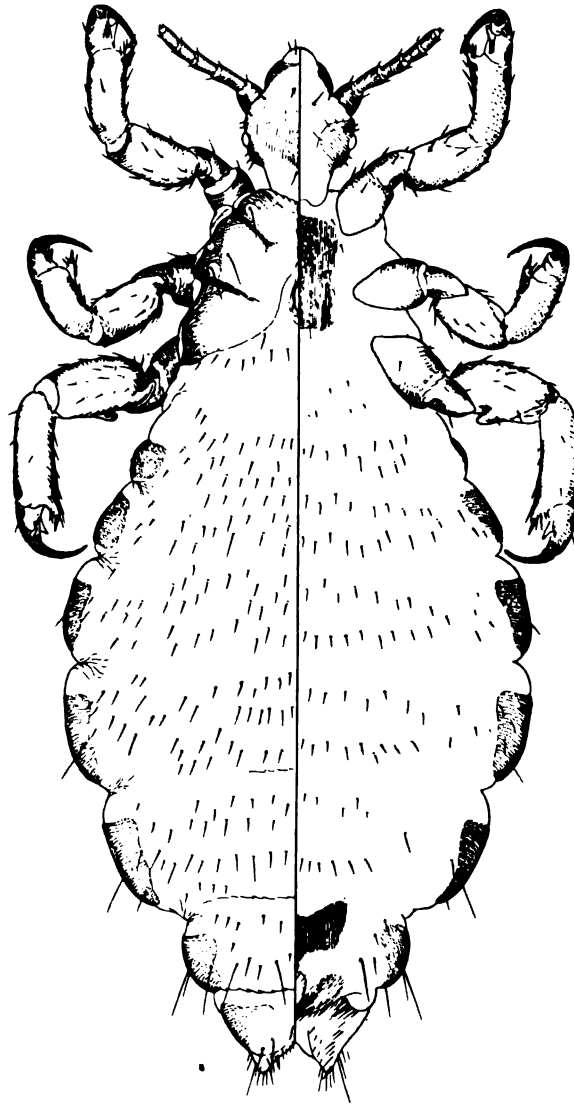

FIG. 306.—*Pediculus humanus* Linnaeus. Typical female of the *"corporis"* form. From man's clothes, Cambridge, England.

Nairobi, Kenya; Nuttall, No. 254, from Suahili Negro's head, Zanzibar; Nuttall, No. 257, from heads of Masai Negroes, Tanga, German East Africa; Nuttall, No. 277, from heads of Kikuyu, hospital at Nairobi, British East Africa; Nuttall, No. 279, from heads of Kavirondo, same locality; Nuttall, No. 281, from blanket of Meru, same locality.

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4. *From Chinese and Japanese.*—Male and female, labeled as "Type" of *Pediculus humanus chinensis* Fahrenholz, "Prov. Fokien, G. Siemssen vend. 8,9.1911," received as a loan from the Hamburg Museum. Two males

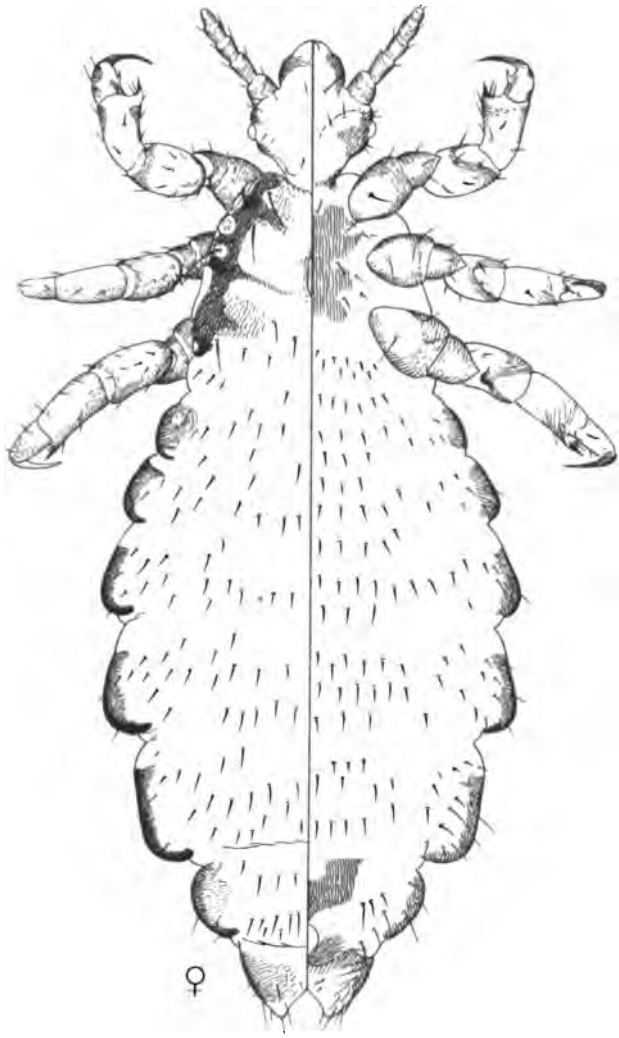

FIG. 307.—*Pediculus humanus* Linnaeus. Female, from material from China determined by Fahrenholz as *P. capitis angustus* Fahrenholz.

and two females from the same museum, labeled as *Pediculus capitis angustus,* and bearing the data, "Prov. Fokien, China, G. Siemssen 1917, det. Fahrenholz, 3: 1917." These are not part of the types but may be

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assumed to represent Fahrenholz' conception of the form. Nuttall, No. 45, from man, Yokohama, Japan—it may be assumed from a Japanese;

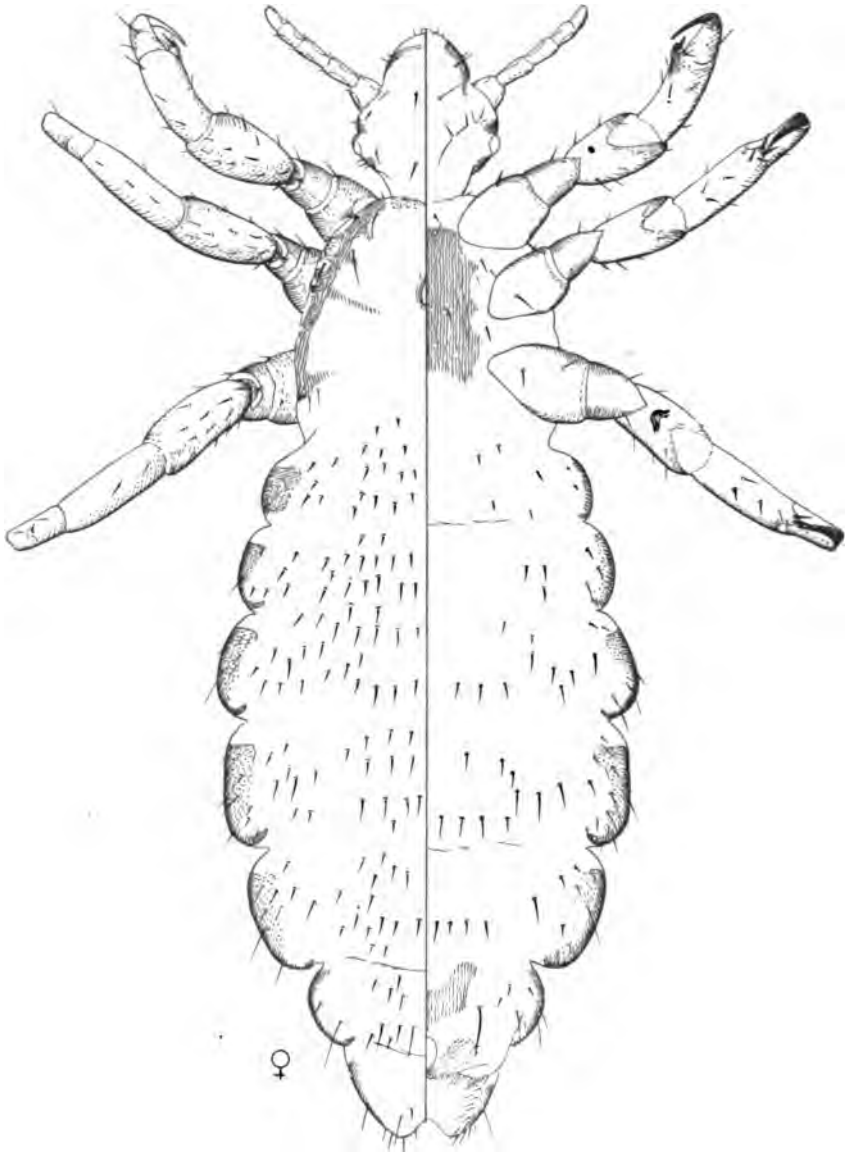

FIG. 308.—*Pediculus humanus* Linnaeus. Female, from the type of *P. humanus chinensis* Fahrenholz.

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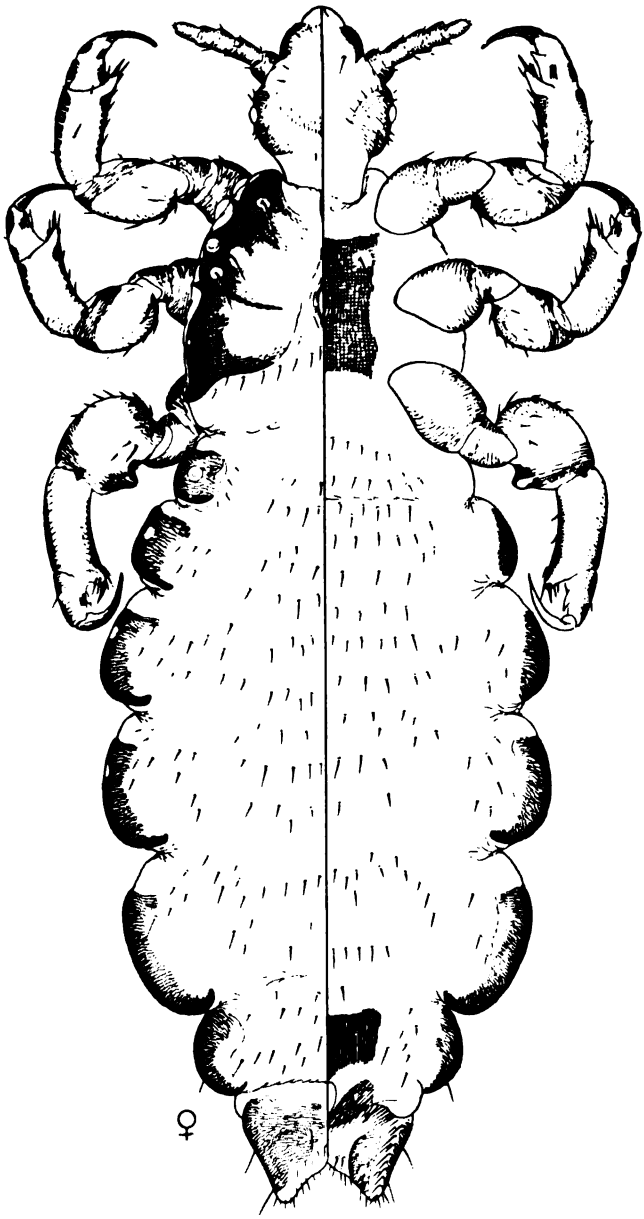

FIG. 309.—*Pediculus humanus* Linnaeus. Female, from a specimen from Tarahumare Indians, Mexico, which comes within the concept of *P. humanus americanus* Ewing.

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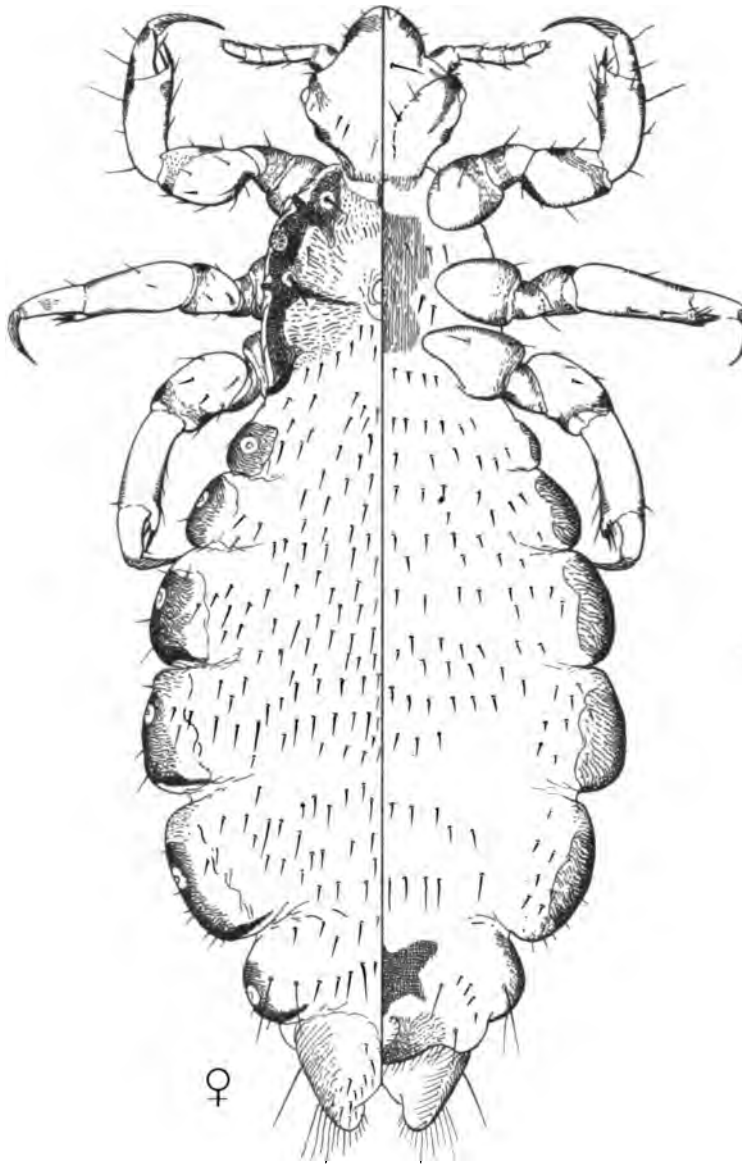

FIG. 310.—*Pediculus humanus* Linnaeus. From the sole remaining, and therefore type, specimen of *P. consobrinus* Piaget, in the British Museum.

Nuttall, Nos. 165 and 179, from Chinese, Szechuen, West China; Nuttall, Nos. 174 and 180, from pony, same locality data.

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5. *From American Indians.*—The type of *Pediculus humanus americanus* Ewing, from mummies, Surco, Peru, and a slide containing four

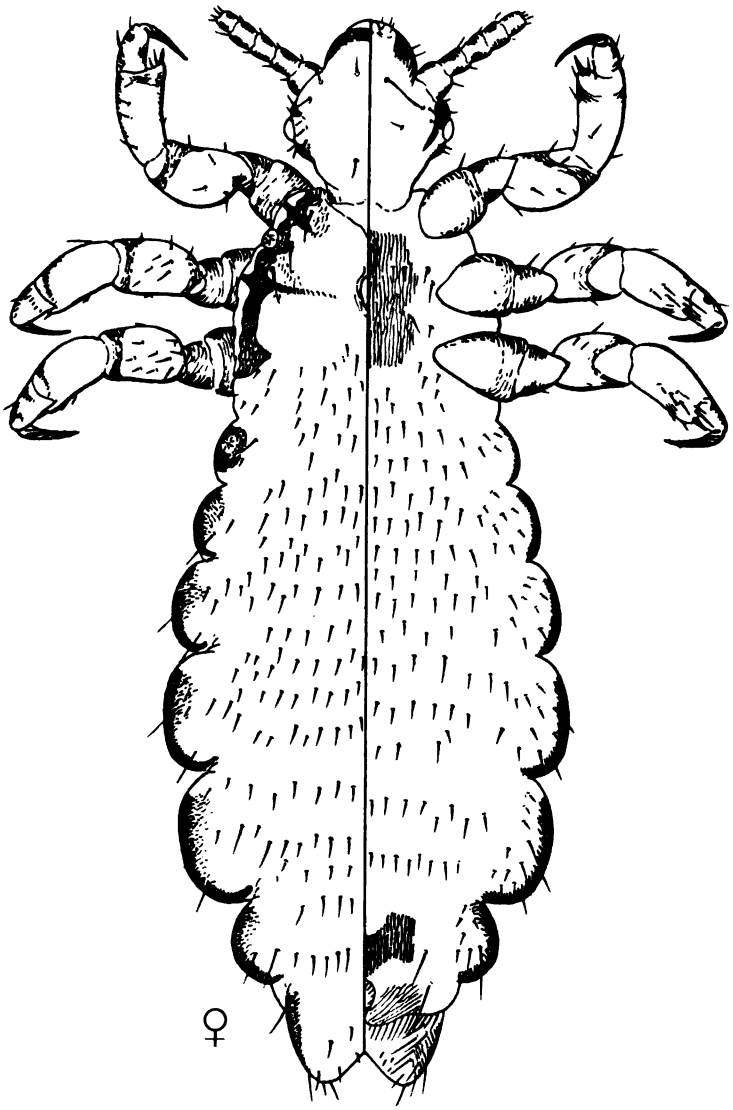

FIG. 311.—*Pediculus humanus* Linnaeus. Female, from a specimen labeled "Type" of *P. assimilis* Fahrenholz.

females and two nymphs from mummies, Canyon del Muerto, New Mexico, being part of the paratype material. From head of Maya Indian, Xhichel.

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near Peto, Yucatán, determined by Ewing as "much nearer to *americanus* than any other variety," and from Indian hut, Santa Emilia, Pochuta, Guatemala; both these lots received from Dr. J. Bequaert. From Tarahumare Indians, northern Mexico, collected many years ago by the explorer Lumholtz and received from the National Museum of Sweden. Nuttall, No. 250, from Indians, Cerro de Pasco, Peru.

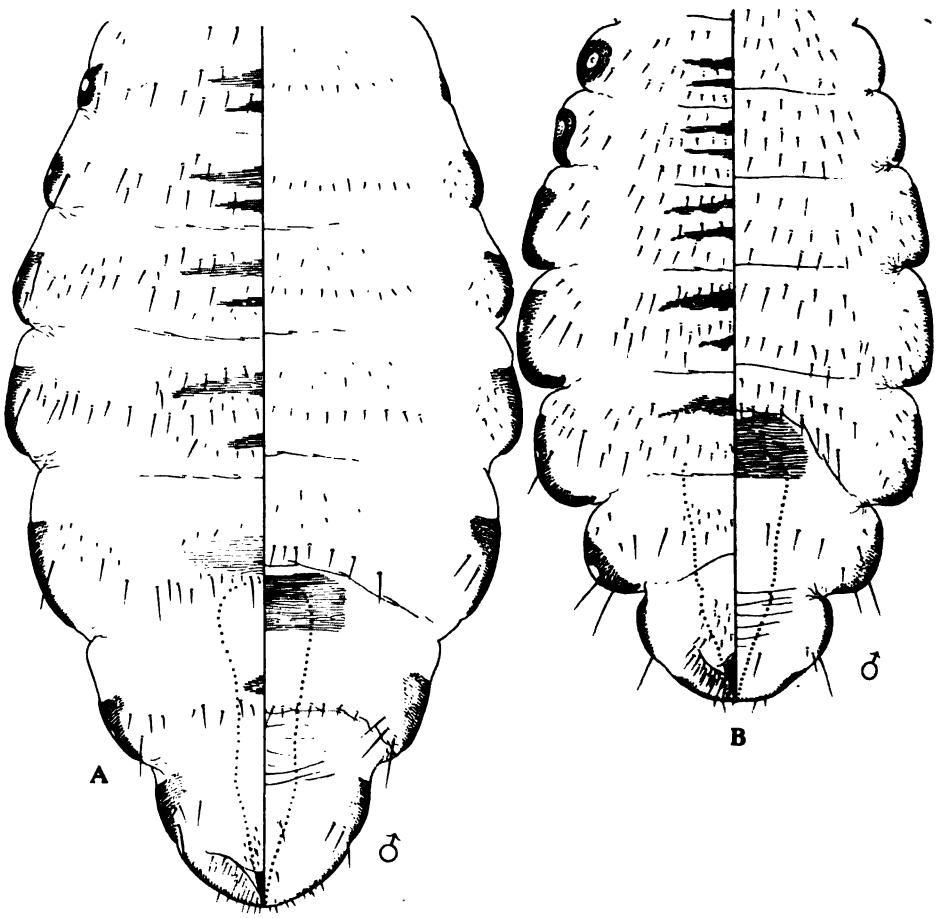

FIG. 312.—*Pediculus humanus* Linnaeus. Abdomens of males of: *A*, *"corporis"* form; and *B*, *"capitis"* form, both from England.

6. *From Eskimo.*—From head of copper Eskimo, Coronation Gulf region, Canadian Arctic Expedition, Stanford Collection, and Nuttall, No. 246. From Eskimo, Frobisher Bay, C. G. Sampson, 1902, Nuttall, No. 40.

7. *From South Sea Islands.*—From heads of natives, Kungana Bay,

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Rennell Island, Templeton Crocker, 1933, Stanford Collection. From Marquesan woman, Hakahetau Village, Uapou, Marquesas, December 3, 1931, Pacific Entomological Survey, and from heads of native children, Hitiaa, Tahiti, November 27, 1928, Pacific Entomological Survey.

8. *From India, and southern Asia.*—Nuttall, Nos. *229a* and *229g*, from heads of Tamil coolies, Federated Malay States; Nuttall, No. 234, from natives of the Badaga tribe, Coonoor, Nilgiris, India; Nuttall, No. 240, from hill woman's head, Kasauli, India; Nuttall, No. 243, from Indian woman's head, Madras, India; Nuttall, No. 244, from heads of coolies, Madras, India; Nuttall, No. 245, from coolies, Madras, India.

9. *Miscellaneous localities.*—Nuttall, No. 90, from Arab, old Biskra, Algeria; Nuttall, No. 209, from clothes, London; Nuttall, No. 263, from head of East Indian boy, Demerara, British Guiana. From man, Camp Meade, Maryland, Stanford Collection. Jail, Singapore, Dr. B. A. R. Gater, Stanford Collection. "Dried head," Mexico City, American Museum of Natural History.

10. *Reared material.*—Laboratory reared, Singapore, Dr. B. A. R. Gater, Stanford Collection. Nuttall, No. 287, "1915 strain of *capitis*, now completely of *corporis* type, received alive from Bacot, 22,XI,1918."

11. *From other Primates.*—The single remaining female specimen of *Pediculus consobrinus* Piaget, which must be regarded as the type and is now in the British Museum, from *Ateles pentadactylus*. Two specimens, received from the Berlin Museum and labeled *Pediculus oblongus* Fahrenholz, apparently not the types, but indicated, as determined by Fahrenholz, from *Hylobates syndactylus* and "von gibbon." From "wollaffen, direkt vom Amazonasgebiet importiert, 19,IV,1923," Hamburg Museum. A single specimen in the British Museum, labeled merely "Parasite of chimpanzee," which is apparently of the *"maculatus"* type.

FEMALE (Plates I and II; Figs. 306–311). A very variable species ranging in length from 2.5 to 4.2 mm., in color from very pale to very dark, in shape from short and compact to elongate and swollen; antennae ranging from shorter than the head to longer than the head (Fig. 313); setae of the abdomen varying from sparse and more or less arranged in rows to numerous and without definite arrangement; gonopophyses varying from short and blunt to almost sickle-like (Fig. 322); thoracic spiracle varying in size (Fig. 316); paratergites (Figs. 318, 319) varying in extent, but never with dorsal and ventral lobes; genital plate of the female variable. Posterior femur (Fig. 326 *H*) with a quite strong ventral spur.

MALE (Plate III). Ranging in length from 2.00 to 3.25 mm. Varying, as does the female, in pigmentation and in form of the paratergal plates. Anterior leg (Fig. 326) with the tibio-tarsus stouter than in the female. Abdomen with tergal plates of variable pigmentation and extent normally

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present on the third to eighth segments, there being two plates on the third to sixth segments and one on the seventh and eighth, but occasionally with a plate developed on the second segment and an additional plate on the eighth, and sometimes with the plates more or less fused. Genitalia presenting no specific peculiarities, the genital plate always present, small and variable in shape (Fig. 329).

Discussion

The special status of the lice of man naturally led to the development of a very extensive literature concerning them, even before their connection with the transmission of disease was suspected. Since the definite proving of that connection, the interest has naturally increased, and it is to this circumstance that we owe practically all of our really reliable information concerning their anatomy, their biology, and even their systematics. It is a strange fact that the total amount of information accumulated concerning this constant companion of man was, until about 1917, insignificant.

We are here concerned solely with the problems of systematics, but the work done upon the biology of *Pediculus humanus,* especially by Nuttall, forms an essential base for systematic studies. Without such work any understanding of the bare facts which may be observed in examining preserved specimens is impossible. And, unfortunately, the total amount of such work is still insufficient to permit a final solution of the problems that appear and that are clearly set by the examination of such material.

The complexities arise from two sources. They come in part from the actual biological situation presented by the insects and in part from the glaring deficiencies of method and the psychological vagaries of presumably scientific workers which have been so clearly demonstrated and so vigorously and justifiably criticized by Nuttall. The fact that Nuttall was demonstrably wrong in certain conclusions in no way detracts from the general truth of his criticisms. One of the most difficult tasks before the student of the systematics of the genus *Pediculus* who is endeavoring to arrive at some understanding of the very real biological problems presented is that of delving through the mass of useless and misleading literature with its enclosures of meaningless names for the mostly imaginary "races" and "subspecies" and "varieties" of *Pediculus humanus* and sifting the truth from the misinformation concerning the other supposed species of *Pediculus* on other Primates.

The development of the situation which now exists, presenting eight supposed "varieties" of *Pediculus* from man, two supposed species from gibbons, two from the chimpanzee, and four or more from New World monkeys, is a long story, but one which must be related in detail in order that we may have a clear approach to the questions involved.

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The nomenclatorial history of *Pediculus humanus* begins with the tenth edition of Linnaeus' *Systema Naturae,* the official starting point for all zoölogical nomenclature. Here he gave no indication of recognizing two forms, but in his *Fauna Suecica* of 1761 he indicated the head- and body-infesting forms as varieties, and in the twelfth edition of the *Systema Naturae* (1767) he numbered these as varieties 1 and 2, respectively, with a short statement of their differences.

De Geer (1778) agreed as to the possibility of recognizing these two varieties and defined them, saying: "on pourroit les distinguer par les dénominations suivantes: (1) *Pediculus (humanus capitis)* cinereus, thorace abdomineque fascia interrupta nigra marginatis; (2) *Pediculus (humanus corporis*) albidus, totus immaculatus." The rule that in the nomenclatorial division of a species one of the segregates must bear the same name as the species, which would have required one of these varieties to bear the name *Pediculus humanus humanus,* was not then even thought of, and the lack of it is at the root of some of our nomenclatorial difficulties in this case.

Question might arise as to whether or not de Geer was actually employing a binomial system in the naming of these varieties. If it be decided that he was not, the validation of these names must be ascribed to Retzius (1783), who presented a translation of de Geer's work with all names in indisputably binomial form and designated these varieties again as *"capitis"* and *"corporis."* The writer is inclined to think that they may as well be ascribed to de Geer, as has always been the custom.

The first fixation of the name *Pediculus humanus* upon one of these varieties rests, as has been pointed out by both Fahrenholz and Nuttall, upon the work of Latreille. The exact date is somewhat obscure, Latreille having published essentially the same material in different works and at different times. Nuttall ascribes it to the *Nouveau Dictionnaire d'histoire naturelle,* of 1803, and Fahrenholz to the *Genera Crustaceorum,* of 1806, while the same material appears in the *Histoire naturelle des crustaces et des insectes* (Vol. 8, p. 94), of 1804. The result, however, is clear: *Pediculus humanus* is stated to be "le pou du corps," and the head louse is named *Pediculus cervicalis,* "le pou de tête." This, being the first fixation of the name, will stand as determining its application if more than one form is nomenclatorially recognized. The attempt by Ewing (1926) to apply the name *Pediculus humanus humanus* to the head louse thus fails, and Enderlein's fixation of the type of *Pediculus* as *P. capitis* de Geer is utterly out of accord with the rules.

Fabricius (1805), while failing to recognize these two supposed varieties, named as new a *Pediculus nigritarum* from the bodies of Negroes, characterizing it as follows: "Paullo minor p. humano. Caput magnum,

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planum, laeve, triangulum, antice subbifidum, atrum. Corpus subrugosum, atrum, immaculatum. Habitat in nigritarum corpore." Were this not preceded by Latreille's work, question might arise as to whether or not this name fixes the application of the name *Pediculus humanus*. Unfortunately there is nothing in this description which permits the recognition of the form named by Fabricius.

Von Olfers (1816), in a dissertation which is now practically inaccessible and which has been seen by Fahrenholz alone of students of the sucking lice, named a *Pediculus nigrescens* from Negroes and renamed the head and body lice as *P. pubescens* and *P. albidior*, respectively. These last two names, being obviously synonyms, cause no difficulty, if we accept the opinions of Fahrenholz.

Nitzsch (1818) recognized *Pediculus capitis* as a distinct species and renamed the body louse as *P. vestimenti*, a name which persisted in literature even until 1925.

Alt (1824) proposed the name *Pediculus tabescentium* for the body louse when occurring in heavy infestations, and this name encumbered the literature for many years.

Although various authors, especially Murray,[8] from time to time indicated a belief that there are differences among the lice from different races of men, none of these supposed forms were formally named, and the literature crystallized around the names *Pediculus capitis*, *P. corporis*, and *P. vestimenti*, until it was disturbed again in 1911. In the meantime, Piaget (1880) named as doubtfully distinct a species, *P. consobrinus*, from a New World monkey of the genus *Ateles;* Mjöberg (1910) named another from the same genus; and Fahrenholz (1910) named *Pediculus schäffi* from the chimpanzee. Except for Meinert (1891), no one seriously questioned the accepted belief that the head and body lice represent two distinct species.

Neumann (1911) concluded that the head and body lice can at the most be regarded only as subspecies, and, disregarding entirely the accepted rules of nomenclature, applied the terms *Pediculus capitis* and *P. capitis vestimenti* to them. On the basis of the literature he expressed the belief that *P. consobrinus* Piaget must be a synonym of *P. capitis*.

Fahrenholz (1912) maintained the distinctness of *Pediculus capitis* and *P. corporis* as species, offering very unconvincing evidence in support of his views, and then (1915) began the extension of his peculiar methods to the recognition of a series of so-called subspecies or varieties. He assumed to recognize *P. corporis* var. *nigritarum* Fabricius on the basis of a single specimen from a Negro, and named as new *P. capitis* var. *angustus*

[8] A. Murray, "On the *Pediculi* Infesting the Different Races of Men," *Transactions Royal Society of Edinburgh*, 22: 567–578; pls. 29–30 (1861).

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Pediculus humanus Linnaeus. Female. typical of the form *"capitis."*
From head of Caucasian, England.

ERRATUM

An error has developed in the arrangement of the accompanying plates. The drawings in Plates I and II should be interchanged.

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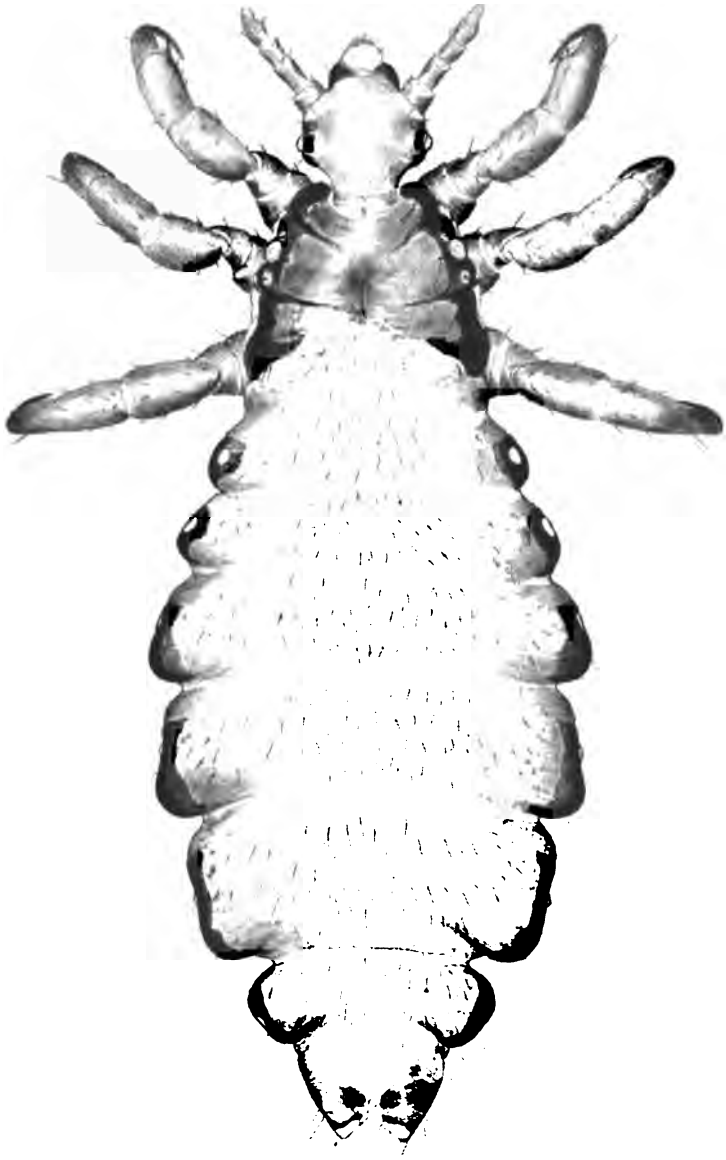

Pediculus humanus Linnaeus. Female, typical of the form "*maculatus*." From Negro, Dutch Guiana.

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Pediculus humanus Linnaeus. Male, typical of the form "*capitis*."
From head of Caucasian, England.

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from Japanese, *P. capitis* var. *maculatus* from Negroes, and *P. corporis* var. *marginatus* from Japanese.

In 1916 he correctly appraised the nomenclatorial situation which requires the name *Pediculus humanus humanus* to be fixed upon the body louse and continued with his attempt to supply each tribe of mankind with its distinct variety of both head and body lice, naming as new *P. humanus* var. *chinensis* from Chinese. He added also *P. friedenthali* and *P. oblongus* from gibbons and a third species, *P. lobatus,* from *Ateles.* The name *Pediculus oblongus,* being preoccupied by *Pediculus oblongus* Geoffroy, was changed by Fahrenholz in 1919 to *P. assimilis.*

During the World War the recognitiion of the importance of the lice of man in the transmission of various diseases led to extensive studies upon them, the most important being those of Sikora, Bacot, and especially Nuttall and Nuttall and Keilin. It is to the work of these two last-named authors that we must go for an understanding of the factors underlying much of our systematic problem.

A large amount of material of lice from man in all parts of the world was accumulated by Nuttall, and extensive experiments in rearing the lice, subjecting them to varied environmental influences, and crossing the two supposed varieties from head and body were carried out. It was Nuttall's conclusion that color is directly influenced by the environment, that the size differences between head and body lice are due to environmental factors, and that at the most "*capitis* and *corporis* merely represent two *unstable races* of one species, *Pediculus humanus* Linnaeus." In a comprehensive examination of the literature dealing with these and the various supposed varieties and species from man and other Primates, all were rejected as being at the most merely races of *P. humanus.*

Undeterred, however, by this evidence, Freund (1924, 1925, 1927) once more raised the claim of specific distinctness for the head and body lice, citing a series of extraordinarily trivial supposed differences which will be considered in detail later in this discussion.

And Ewing (1926, 1933), while accepting the conclusion that the head and body lice of Europeans do not constitute distinct species, clings still to the belief that they represent subspecies. Although unable to accept the extreme view of Fahrenholz, which assigns three names to lice of Chinese and Japanese, he has assumed to recognize one of these forms on the basis of two male specimens, to recognize the *Pediculus nigritarum* of Fabricius, and to name still another subspecies, *Pediculus humanus americanus,* from American Indians.

A detailed examination of the claims for recognition of each of these supposed forms is necessary. We may begin with an examination into typical head lice and body lice of Europeans.

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The Status of Pediculus "Capitis" and Pediculus "Corporis"

It has been quite generally agreed that certain obvious differences exist between lice occurring normally in the hair and those occurring normally on the body and in the clothing of members of the white race. As was pointed out by Linnaeus and de Geer, the head lice tend to be smaller, more compact, and more heavily pigmented; the body lice to be larger, more flaccid, and paler, with the lobing of the abdomen less sharply defined. Given a few specimens of thoroughly typical head lice and a few of thoroughly typical body lice, almost any systematist basing his conclusions on these specimens alone would be inclined to call them different species.

To the older authors, working with but small quantities of material and entirely lacking experimental evidence of the meaning of these apparent differences, such a conclusion seemed abundantly justified. But the examination of a wide range of material makes it impossible to accept such bases as adequate, for every degree of size from the smallest to the largest, every degree of pigmentation from the darkest to the palest, every degree of lobing of the abdomen from the deepest to the slightest, and, it may safely be asserted, every combination of these characters can be found. Furthermore, experimental evidence seems positively to demonstrate that these differences are at least in large measure due to environmental influences and not to differences primarily of a genetic nature.

Nuttall, in a series of experiments reported in *Parasitology* (Vol. 11, pp. 201–220 [1919]), reared lice from a common source under carefully controlled conditions. He concludes (p. 219) that "pigmentation in *Pediculus* is not an hereditarily transmitted character, its presence depends entirely upon the nature of the background upon which the insect lives and it is a character that may be acquired in a couple of days." There seems to be no reason for questioning his conclusions, and this supposed difference between *"capitis"* and *"corporis"*[4] must be discarded.

Nuttall has also considered (1920, pp. 144–147) the matter of differences in size. He called attention to the fact that in this genus precise measurement is practically out of the question, owing to the general flaccidity of the insects, few fixed points for measurement being available. This observation the writer will confirm. Gross size is extremely variable in the living insect, owing to differences produced by feeding or other factors. Precise measurement of minor parts, except of the legs, is impossible. Microscopic preparations present so many sources of error, owing

[4] Purely as a matter of convenience these names will be used in this discussion simply to mean "lice of the head-louse type" and "lice of the body-louse type."

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to expansion or collapse or distortion, that the percentage of error in measurements of even a harder part, such as the head, is excessively large. Furthermore, as Nuttall has shown, there is such a complete intergradation in size that such measurements cannot be considered significant.

The prevalence of distortion in microscopic preparations is a factor to which but little attention has been paid, but it undoubtedly accounts for some of the alleged differences which various authors have presented. For example, Fahrenholz notes in his description of *P. friedenthali* that "das Abdomen ist recht schlank." It is evident from the photograph in Plate I, Figure 1, accompanying his description that this slenderness is that of a contracted specimen, this shape being duplicated in specimens at hand in which the longitudinal contraction folds can be seen. He remarks further that "Ein gutes Unterschiedungsmerkmal scheint mir das letzte Segment des Weibchen zu bieten; es ist nämlich breiter als lang und daher ragen die Gonopoden in die Einschnitt desselben hinein." It is obvious from his accompanying figure that his specimen was distorted. And so with other instances which could be cited where authors have gravely discussed these ephemeral appearances.

The lobing of the abdomen has been regarded as distinctive, typical *"capitis"* having the intersegmental incisions very deep. But it is evident that this appearance depends to a very considerable degree upon the amount of distension of the body, although there are certain accompanying structural differences which will be discussed later. Nuttall, on the basis of an extensive experience in the rearing of these insects, concluded (1919, p. 344) that "greatly increased internal pressure, consequent upon the habit of gorging, although induced periodically, would appear to me to explain the larger average size of *corporis,* particularly the stretching of the thinner portions of the integument, especially the increase in the size of the abdomen coupled with the loss of angularity in the abdominal segments and the more widely separated hairs upon the abdominal surface."

The supposed differences in habitat, likewise, have been disposed of by Nuttall, who points out that they do not hold, and further demonstrates that the supposed morphological differences already cited disappear in specimens reared in the laboratory: "typical *capitis* lose all their distinctive morphological characters when raised experimentally on man under conditions which are favourable for the propagation of *corporis,* and they acquire all the morphological characters of *corporis* after four or more generations."

Recognizing that these superficial differences are inadequate to permit the separation of the two forms, various authors have sought to find actual structural differences, however small, upon which we may rely. We may proceed to an examination of the various structures which are available

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as a possible source of differences. Since these two forms were originally based upon the lice of Europeans, our conclusions concerning them should be based upon material from the same general source in order to preclude the chance that other varieties have been introduced into the discussion. There are at hand no specimens from continental Europe, but certain lots from England may be regarded as meeting the essential conditions, it not being at all likely that even the most extreme "splitter" would attempt to establish them as separate varieties. The lots recorded as from "woman's head" at Cambridge may be accepted as typical *"capitis"* and those from "tramp's shirt" and "man's clothes" at Cambridge as typical *"corporis."*

The antennae.—In Figure 313 *B* is shown an antenna of *"corporis"* and in Figure 313 *H* one of typical *"capitis."* It may be noted that the ratio of lengths is about 5–4 and that the antennae of *"corporis"* seem to be the more slender. This difference has long been recognized and is noted by Nuttall. However, gradations between the two extremes appear in material which may reasonably be used in this comparison.

The head.—In Figure 314 *D* is the head of typical *"capitis"* and in Figure 314 *E* the head of typical *"corporis."* Aside from the actual difference in size and the somewhat more slender and elongate "neck" of the former, there is no noticeable difference. These drawings are from specimens mounted directly into balsam, appearing to be undistorted except for perhaps a slight shrinkage. The shape of the "neck" can be materially altered in the making of a preparation. There is certainly nothing significant here.

The thorax.—Ewing has indicated the existence of differences in the lengths of the large setae (Fig. 315 *A*) on the dorsum of the thorax, these being "shorter" in *"corporis."* Even if considerable differences in these setae exist, it would be impossible to make use of them, for only occasionally are they so flattened in a preparation that their true length can be determined.

Ewing has likewise indicated differences in the size of the thoracic spiracles. In Figure 316 *E* is a spiracle from typical *"capitis"* and in Figure 316 *F* one from typical *"corporis."* The two are almost exactly the same size. Relative to the size of the bodies it is obvious that the spiracle of the former is the larger, but the amount is so slight that any attempt to express it quantitatively would be defeated by the inescapable error in measurement.

The sternal plate of the thorax is always present, although at times obscured in preparations because of faint pigmentation. It is very variable in form and presents nothing characteristic. Typical forms are shown in Figure 317.

The legs of *"corporis"* are perhaps somewhat longer and more slender. Such difference as may exist is insignificant.

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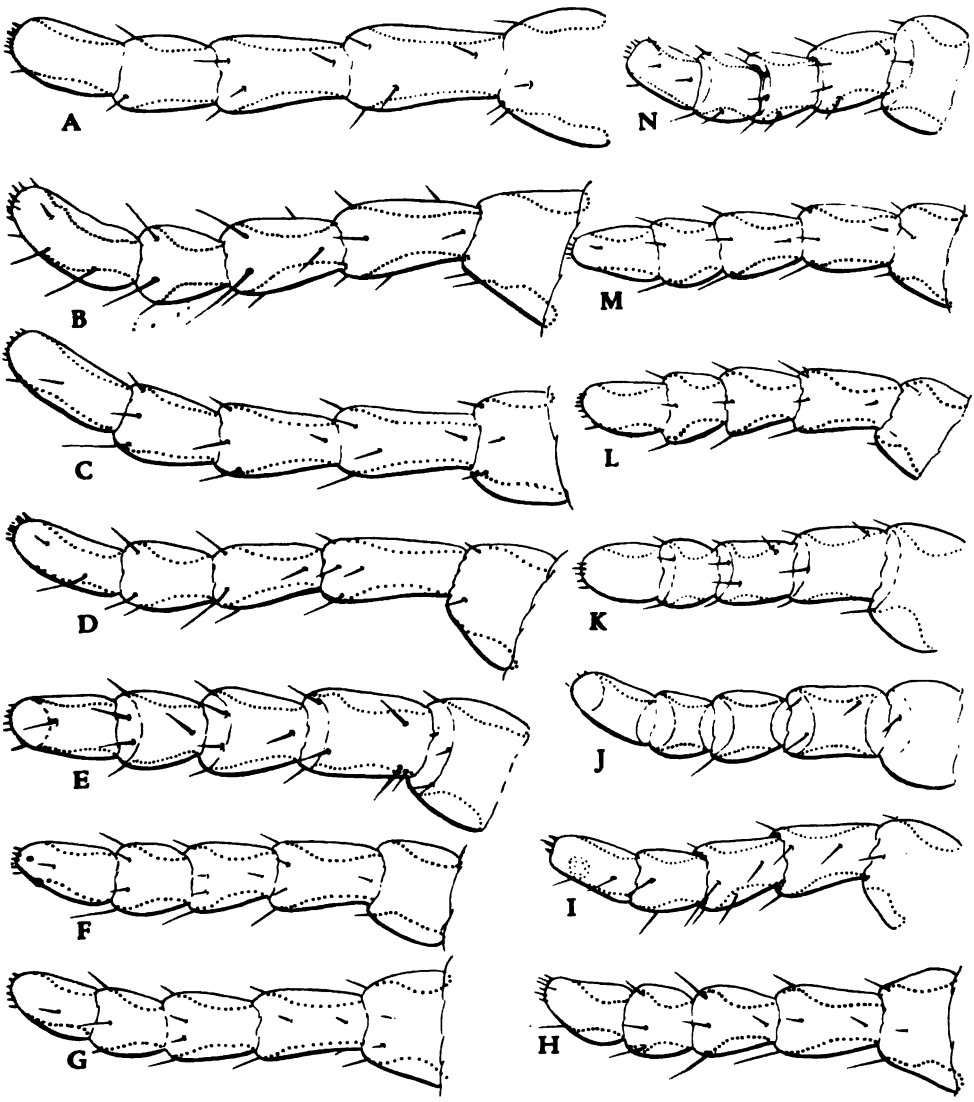

FIG. 313.—*Pediculus humanus* Linnaeus. Antennae of females from: *A*, type of *P. humanus "chinensis"*; *B*, *"corporis,"* England; *C*, *"nigritarum,"* Belgian Congo; *D*, *"corporis,"* laboratory reared, Singapore; *E*, *"angustus,"* China, determined by Fahrenholz; *F*, *"americanus,"* from Tarahumare Indians, Mexico; *G*, head of Sudanese, Khartoum, Africa; *H*, *"capitis,"* England; *I*, *"consobrinus,"* type; *J*, type of *"americanus"*; *K*, type of *"assimilis"*; *L*, *"americanus,"* Indian hut, Guatemala; *M*, *"americanus,"* head of Maya Indian, Xhichel, Yucatán; *N*, *"maculatus,"* from Negro, Paramaribo, Dutch Guiana.

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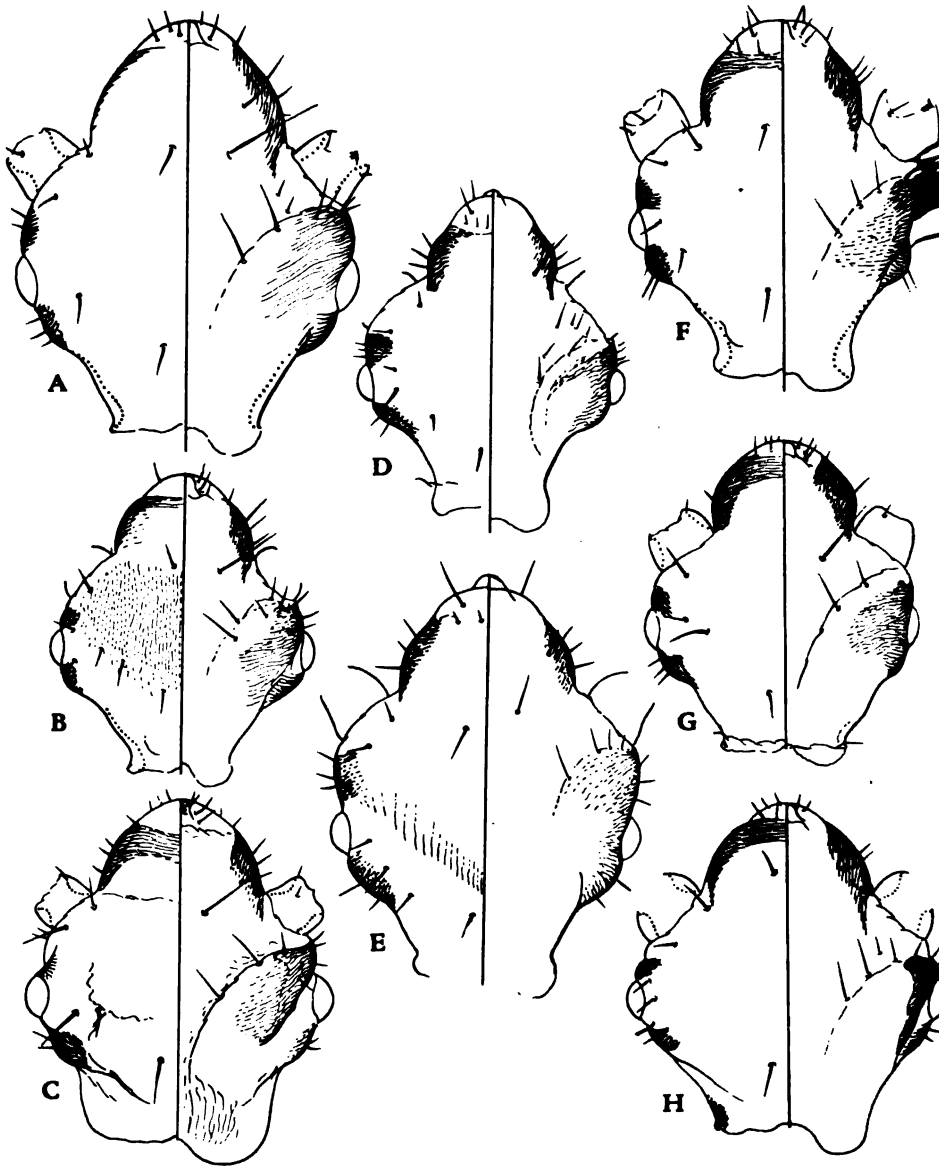

FIG. 314.—*Pediculus humanus* Linnaeus. Heads of females from: *A*, type of *"chinensis"*; *B*, *"maculatus,"* from Negro, Paramaribo, Dutch Guiana; *C*, type of *"consobrinus"*; *D*, *"capitis,"* England; *E*, *"corporis,"* England; *F*, *"angustus,"* China, determined by Fahrenholz; *H*, type of *"assimilis."* *P. lobatus* Fahrenholz, *G*.

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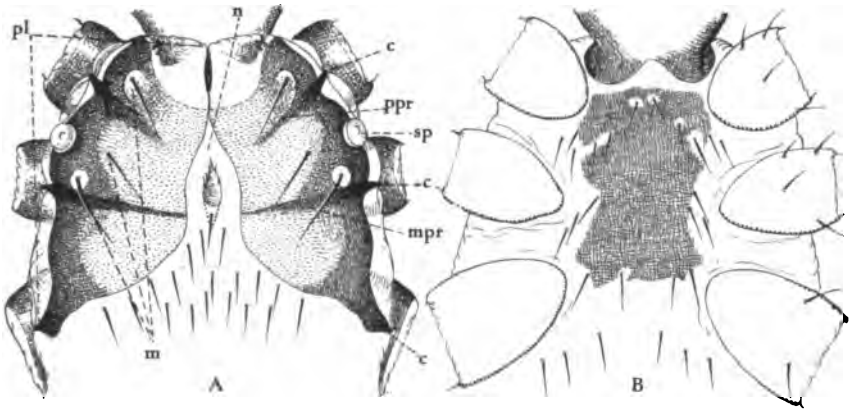

FIG. 315.—*Pediculus humanus* Linnaeus. *A*, dorsal aspect of thorax (*pl*, pleurum; *n*, notum; *m*, thoracic macrochaetae; *ppr*, pleural ridge of prothorax; *mpr*, pleural ridge of mesothorax; *sp*, spiracle; *c*, coxal condyles); *B*, ventral aspect.

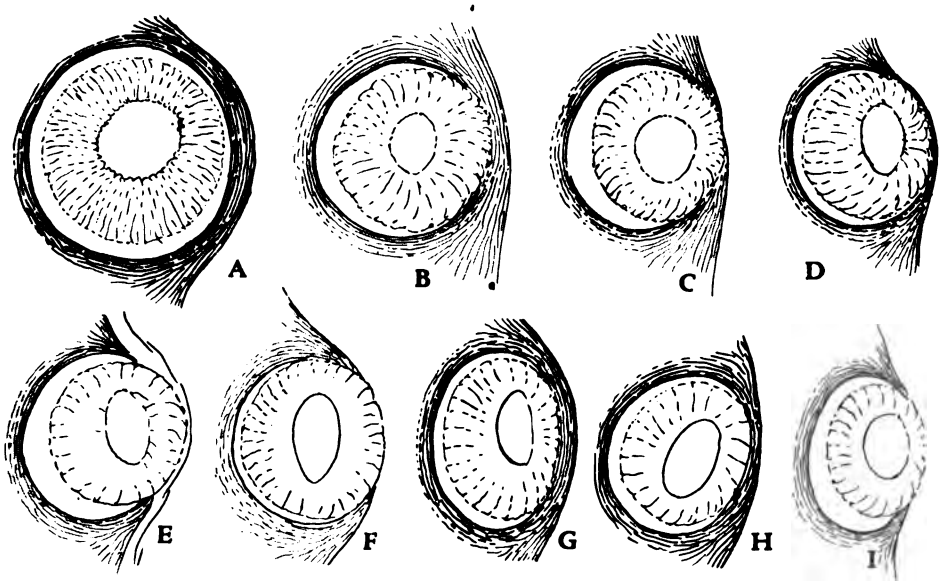

FIG. 316.—*Pediculus humanus* Linnaeus. Thoracic spiracles of females of: *A*, *"maculatus,"* from Wanyaruanda Negro, Belgian Congo; *B*, *"maculatus,"* from Masai Negro, Nairobi, Africa; *C*, *"maculatus,"* from Wanyaruanda Negro; *D*, *"maculatus,"* from Negro, Paramaribo, Dutch Guiana; *E*, *"capitis,"* England; *F*, *"corporis,"* England; *G*, *"angustus,"* China, determined by Fahrenholz; *H*, *"americanus,"* from Tarahumare Indians, Mexico; *I*, *"americanus,"* from Indian hut, Guatemala.

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Distribution of abdominal setae.—No differences greater than might be expected to come within the range of normal variation in number and size have been observed.

Form of paratergal plates.—Here, as between perfectly typical representatives of the two forms, there is an actual morphological difference.

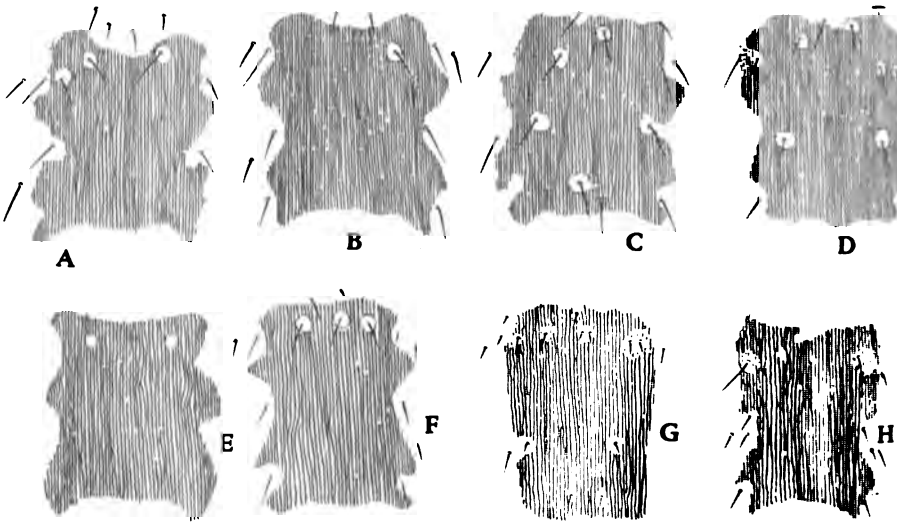

FIG. 317.—*Pediculus humanus* Linnaeus. Thoracic sternal plates of females from: *A, B, "maculatus,"* from Wanyaruanda Negro, Belgian Congo; *C, D, "maculatus,"* from Masai Negroes, Nairobi, Africa; *E, "maculatus,"* after Fahrenholz; *F, "nigritarum,"* after Fahrenholz; *G,* typical *"corporis"; H, "angustus,"* China, specimen determined by Fahrenholz.

Referring to Figure 318 *A* and *C*, and Figure 319 *A* and *B*, it will be noted that in *"capitis"* the plates on the fifth to eighth segments extend entirely around the lateral lobe of the segment and well into the intersegmental incision, the posterior portion of the plate being especially heavily sclerotized, whereas in *"corporis"* the plates merely form a cap over the lateral border of the segmental lobe, not extending into the intersegmental incision. It is this difference which accounts for the more sharply defined and more angular lateral lobes of *"capitis"* and its less flaccid abdomen. However, even in material from England, every degree between these two extremes exists, there being specimens which cannot be referred to either typical form (compare Fig. 318 *B*), although it seems certain that the difference between the two extremes cannot be ascribed merely to the enlargement and stretching of the abdomen of *"corporis."* To make use of the exact shape

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of the paratergal plates in discriminating between the two forms is impossible, for in dissecting them off and flattening them a very large amount of distortion is almost inevitable. The appearance of the plates, as viewed laterally, is shown in Figure 319 *A* and *B*.

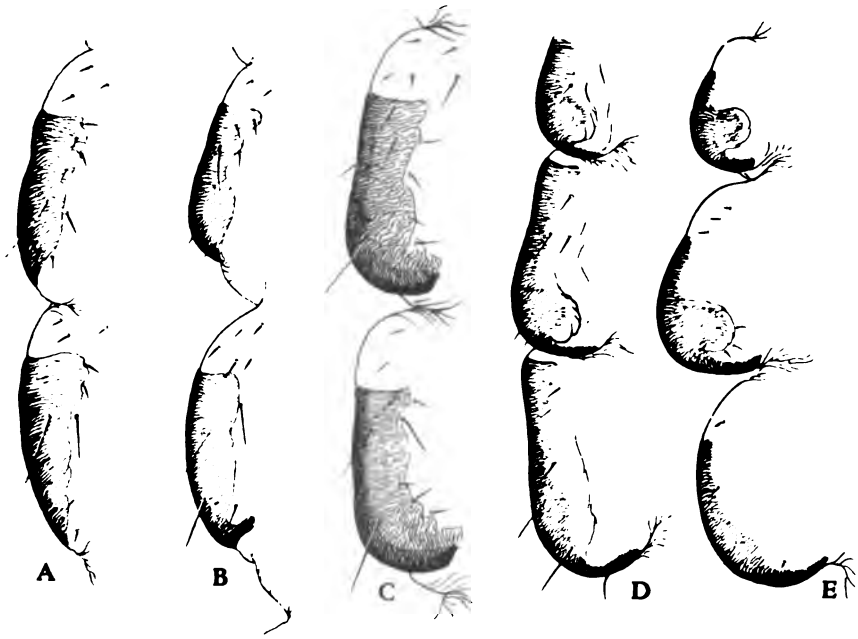

FIG. 318.—*Pediculus humanus* Linnaeus. Paratergal plates of fifth and sixth abdominal segments of females: *A*, typical *"corporis"*; *B*, intermediate form on Wanyaruanda Negro, Belgian Congo; *C*, typical *"capitis"*; *D*, *"americanus,"* from Maya Indian, Xhichel, Yucatán, showing suggestion of the condition found in *Pediculus mjöbergi* Ferris, *E*, from *Ateles dariensis*.

Tergal plates of the male.—It may be regarded as certain that the tergal plates are always to some extent developed in the male (Fig. 320). In pale specimens and unfavorable preparations they may be difficult to see. As between *"capitis"* and *"corporis"* there are no differences except in degree of pigmentation.

Genital region of the female.—Freund, having made a meticulously detailed study of the genitalic region of the females of *"capitis"* and *"corporis,"* apparently upon the basis of very few specimens, came to the conclusion, as had earlier workers, that differences appear which may be relied upon for separation of the two forms. In Figure 321 is shown the genitalic region of each. The so-called telson of Freund is the ninth segment. We may

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consider his arguments in detail. His paper of 1925 is quoted. Even at this date he employs the name *"vestimenti"* instead of *"corporis."*

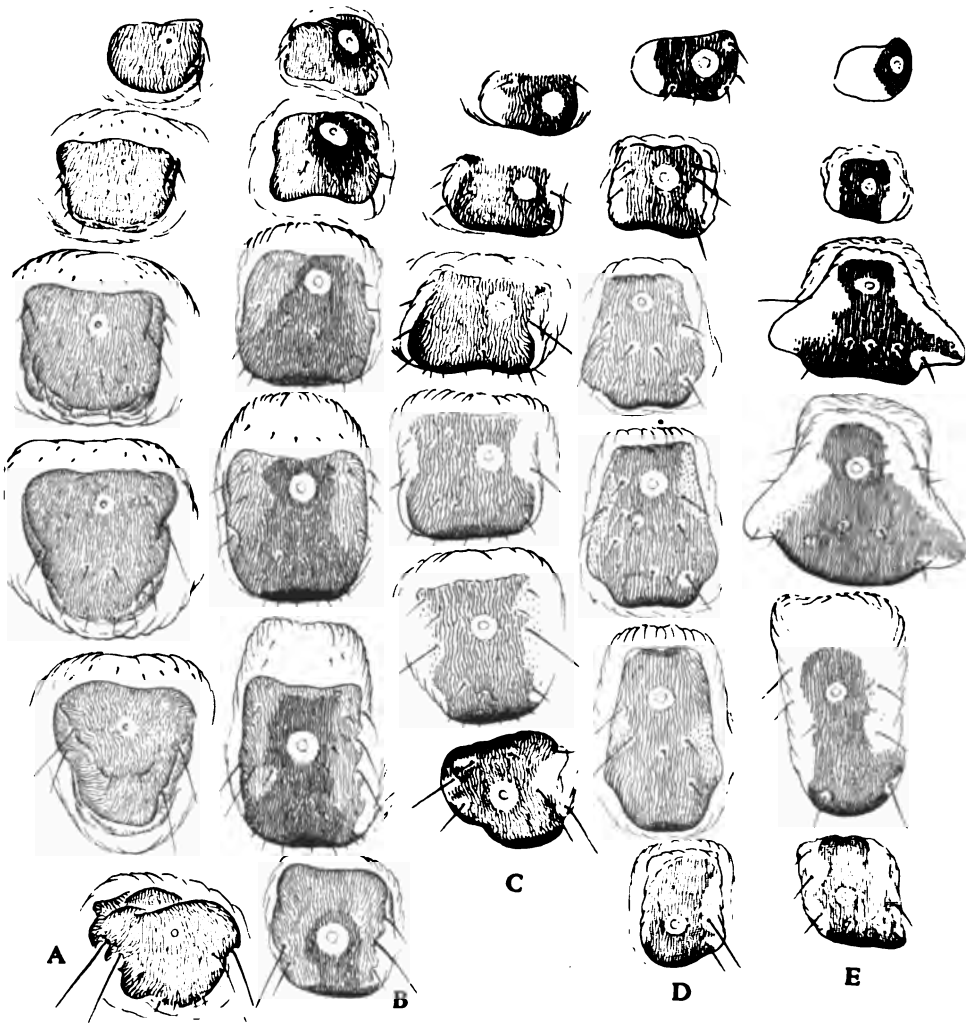

FIG. 319.—*Pediculus humanus* Linnaeus. Paratergal plates of females, dissected off and viewed laterally: *A*, typical *"corporis"*; *B*, typical *"capitis"*; *C*, *"maculatus,"* from Negro, Belgian Congo; *D*, from Marquesan woman, Marquesas Islands. *Pediculus mjöbergi* Ferris, *E*, from *Ateles dariensis*.

"1. Pediculus vestimenti besitzst schlanke Telsonzapfen, während sie bei Pediculus capitis breit sind."

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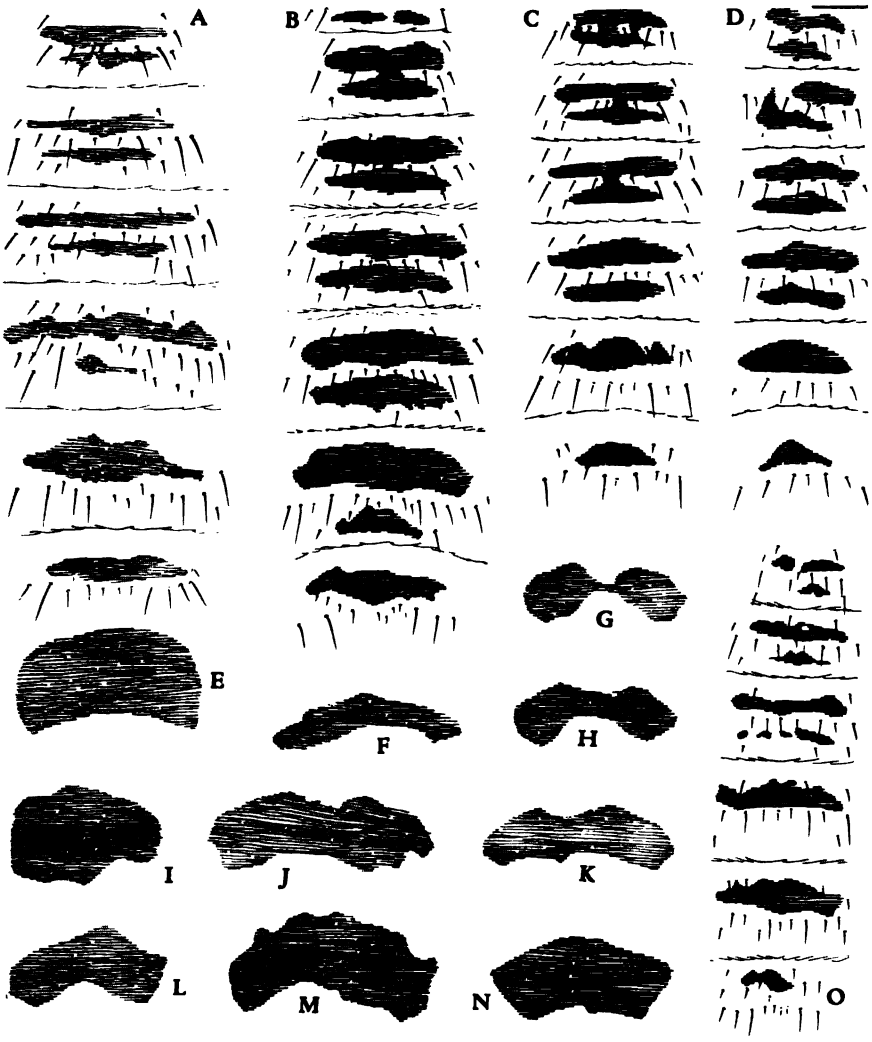

FIG. 320.—*Pediculus humanus* Linnaeus. Tergal abdominal plates of males: *A*, typical *"corporis"*; *B*, *"maculatus,"* from Negro, Belgian Congo; *C*, from natives, Kungana Bay, Rennell Island, South Pacific; *D*, *"americanus,"* from Maya Indian, Xhichel, Yucatán, showing slight abnormality; *O*, from native children, Panama, showing marked reduction and division of plates. Genital plate of males from: *E*, typical *"corporis"*; *F*, *J*, Wanyaruanda Negroes, Belgian Congo; *G*, "dried head," Mexico City; *H*, *"americanus,"* Xhichel, Yucatán; *I*, Marquesan woman, Marquesas Islands; *K*, Sudanese, Khartoum, Africa; *L*, natives, Panama; *M*, natives, Kungana Bay, Rennell Island, South Pacific; *N*, *"americanus,"* Tarahumare Indians, Mexico.

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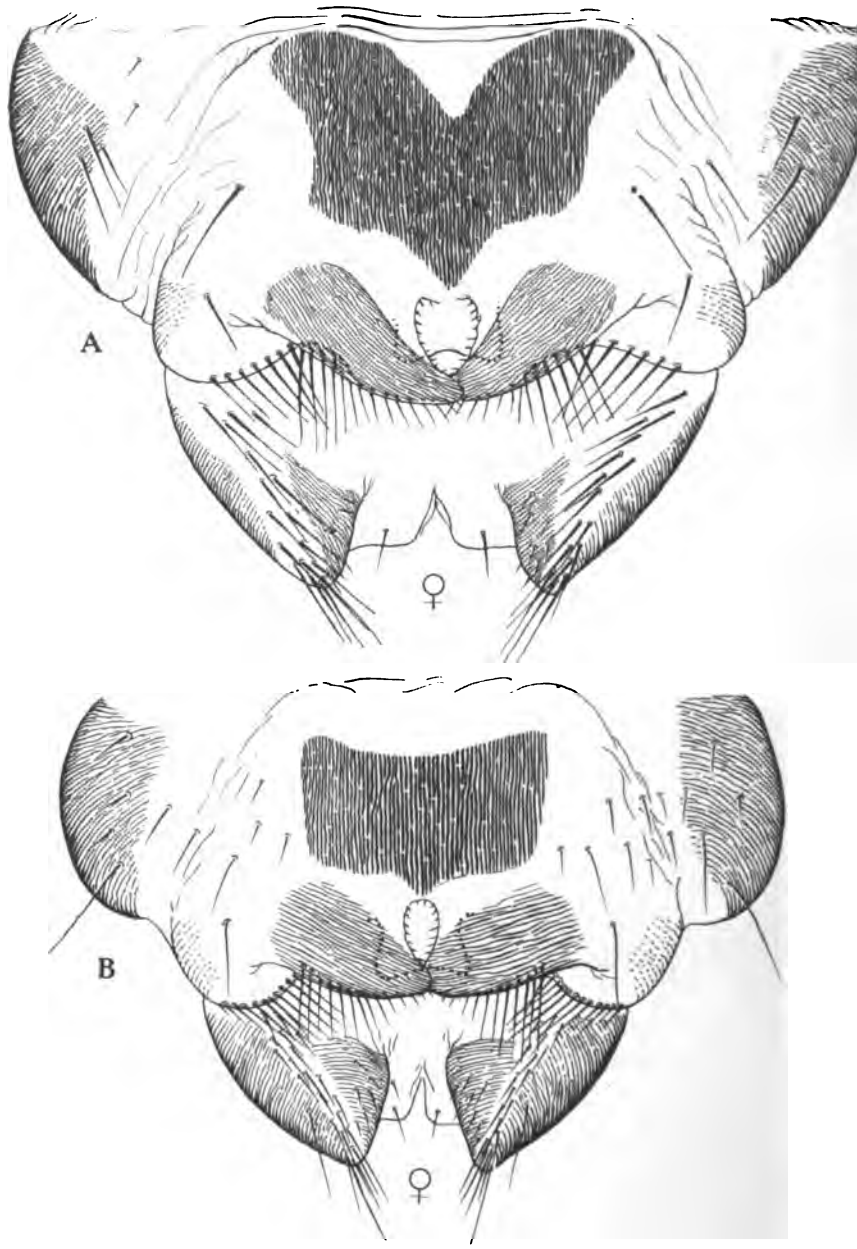

FIG. 321.—*Pediculus humanus* Linnaeus. Genitalic region of females of: *A*, typical *"corporis"*; *B*, typical *"capitis."* Both from England.

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The appearance of this region changes to such a degree with a slight shrinking of the specimen or a change in the angle at which it lies that this supposed difference is evidently entirely fortuitous.

"2. Dementsprechend bleibt bei Pediculus vestimenti das Zwischenfeld zwischen den beiden Telsonzapfen, welches die Analspalte birgt, breit und bei Pediculus capitis schmal."

This appearance may be seen in the figures. The difference is at the most slight and is probably associated with the generally enlarged abdomen of *"corporis."* Actually either form may be seen in either type, and the appearance alters with the condition of the specimens.

"3. Der Borstenbesatz der Telsonzapfen, sowohl der sagittal gestellten ventralen Borstenreihe, wie auch der borsten auf der Zapfenspitze ist schütter bei Pediculus vestimenti, die Zahl der Borsten gröszer, der Besatz daher viel dichter bei Pediculus capitis."

If any such difference exists, it is exceedingly slight and inconstant.

"4. In der Zwischenregion zwischen den ventralen Borstenreihen der Telsonzapfen finden sich bei Pediculus vestimenti nur wenige kurze Borsten, zahlreiche dagegen bei Pediculus capitis."

No such difference appears in any available specimens.

"5. Bei Pediculus vestimenti sind die Gonopoden—was schon Fahrenholz aufgefallen ist—schlank, sichelförmig gebogen, bei Pediculus capitis breit, fast ein gleichseitiges Dreieck bildend, wenn überhaupt so wenig gebogen, mit nur schwach gebogenen Medial—und caudal Kanten."

These differences at times exist, as has been pointed out by various writers, and are shown in the specimens here figured (Fig. 322, *C* and *G*). But every degree of difference between the two extremes can be found. For example, specimens from Nuttall's lot 209, "from clothes, London," which on every other count are typical *"capitis,"* are in this particular character typical *"corporis."*

"6. Zwischen den oralen Ursprung der medialen Gonopodenkanten, kaudal vom Genital fleck, liegt bei Pediculus capitis eine gruppe dicht gestellter, kurzer, dicker Borsten, während bei Pediculus vestimenti Börstchen überhaupt fehlen oder sich nur einige wenige dünne nachweisen lassen."

This exceedingly trivial supposed character is entirely variable, either appearance occurring in either type.

"7. Auf der Medialkante der Gonopoden stehen bei Pediculus vestimenti dünne, kurze Börstchen in einer Reihe entlang der Kante, bei Pediculus capitis sind diese dick und dichter angeordnet."

A very variable character.

"8. Auf der Kaudalkante der Gonopoden entspringen die lateralen langen Borsten bei Pediculus vestimenti knapp innen vom Rande, während

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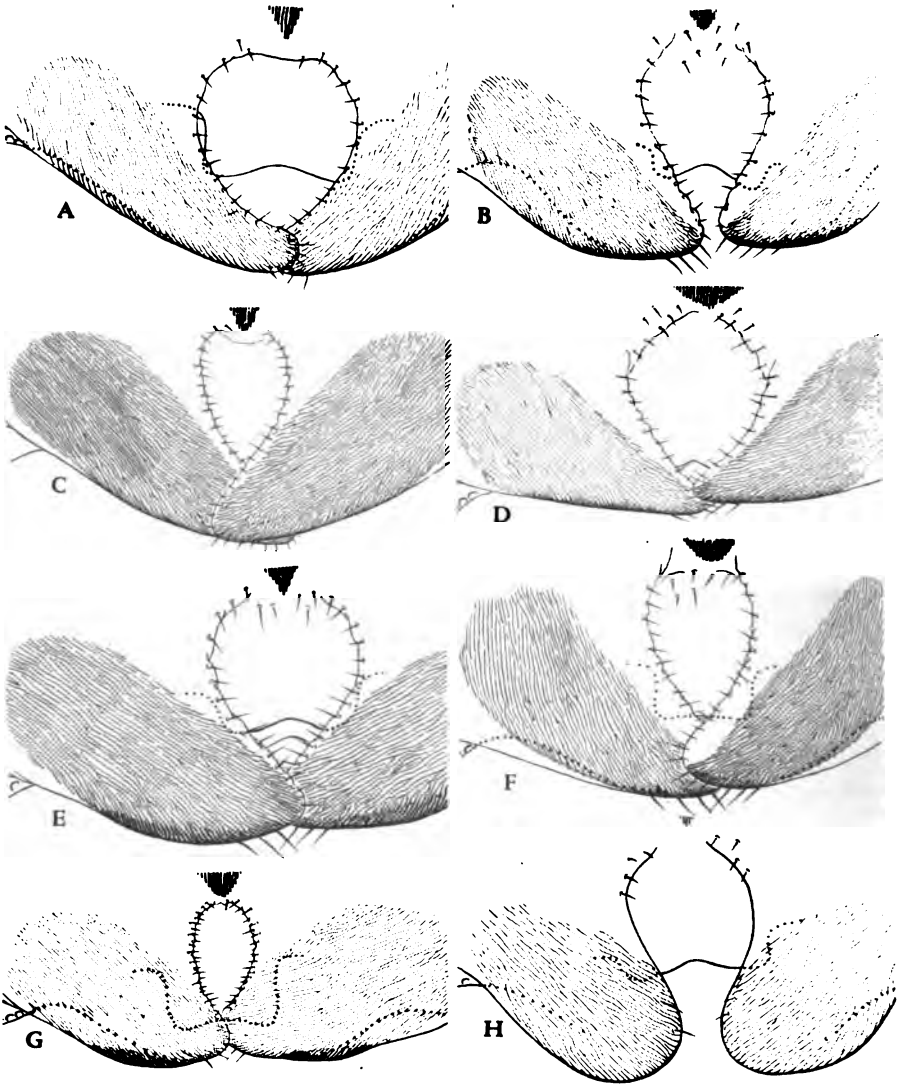

FIG. 322.—*Pediculus humanus* Linnaeus. Gonopophyses of females of: *A*, typical "*corporis*," laboratory reared, Singapore; *B*, "*americanus*," from Maya Indian, Xhichel, Yucatán; *C*, typical "*corporis*," man's clothes, England; *D*, "*maculatus*," Wanyaruanda Negroes, Belgian Congo; *E*, "*angustus*," China, determined by Fahrenholz; *G*, typical "*capitis*," England. *Pediculus mjöbergi* Ferris, *F*, from *Ateles dariensis*, Panama. *Pediculus schäffi* Fahrenholz, *H*, from chimpanzee, London Zoölogical Gardens.

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deren Ursprung bei Pediculus capitis weit oralwärts auf die Innenfläche verschoben ist."

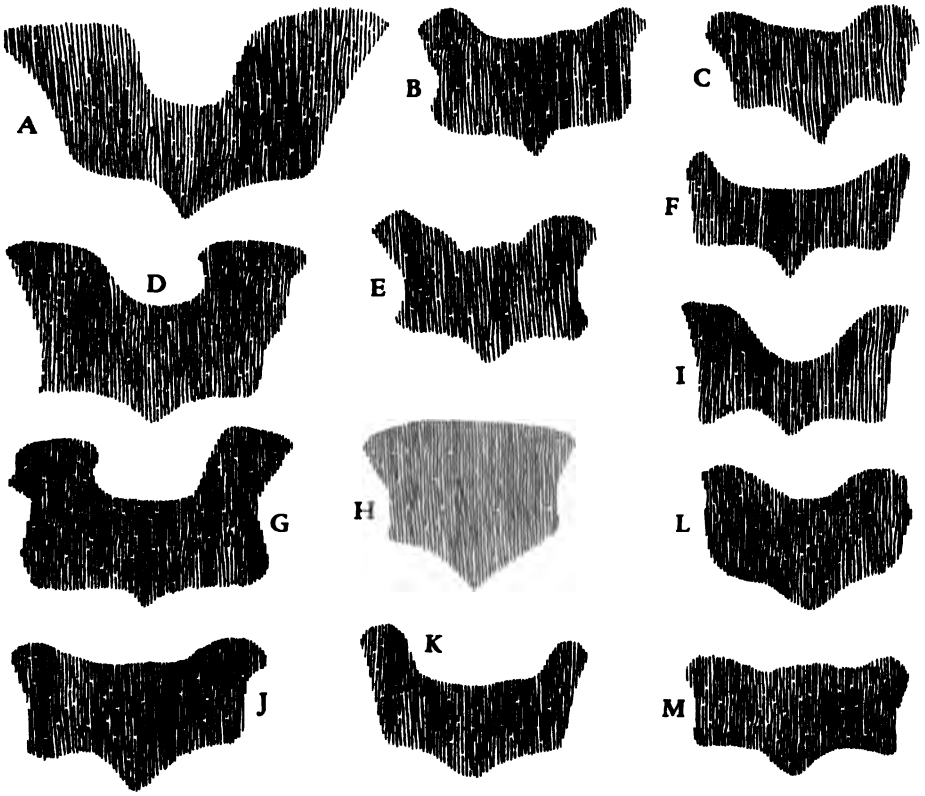

FIG. 323.—*Pediculus humanus* Linnaeus. Genital plates of females from: *A*, typical *"corporis,"* England; *B*, typical *"capitis,"* England; *C*, *"maculatus,"* from Negro, Dutch Guiana; *D*, *"angustus,"* determined by Fahrenholz; *E*, *"americanus,"* Indian hut, Guatemala; *F*, *"americanus,"* Maya Indian, Xhichel, Yucatán; *G*, *H*, *J*, *K*, *L*, *M*, *"maculatus"* and intermediate forms, from Wanyaruanda Negroes, Belgian Congo. *Pediculus mjöbergi* Ferris, *I*, from *Ateles dariensis*, Panama.

Another trivial and inconstant, if not wholly imaginary, difference.

"9. Die Reihe der langen kaudalen Gonopodenborsten geht lateral auf den zwischen Gonopodenursprung und Telsonzapfen eingeschalteten Basalwulst im Bogen über. Die senkrecht an diese anstoszende ventrale Borstenreihe der Telsonzapfen trifft sie bei Pediculus vestimenti im letzten Drittel, während sie bei Pediculus capitis an das ende der Gonopodenborstenreihe anschlieszt."

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An entirely imaginary difference, the existence of which depends upon the contraction or expansion of the specimen.

The genital plate of the female has apparently not been used in attempts to separate these two forms, although there is a tendency toward a difference, the plate in *"corporis"* (Fig. 323 *A*) tending to be larger and with a deeper anterior emargination than that in *"capitis"* (Fig. 323 *B*). The difference, however, is at the most merely a slight tendency, the plate being exceedingly variable.

The male.—In the case of the males, in which few authors assume to have found any particular differences other than those of size, pigmentation, and length of the antennae, Freund (1927) offers definitive characters. We may analyze these in the same fashion as in the case of the female. In the quoted statements, (*a*) signifies *"capitis"* and (*b*) signifies *"corporis."* Reference may be made to Figure 324.

"1. das 9. Segment: (*a*) schmal, scharf vom 8. abgesetzt, (*b*) breit, weniger scharf abgesetzt."

If it exists at all, this supposed difference would correlate with the stronger development of sclerotization in *"capitis."*

"2. Kaudalpol: (*a*) verjungt, (*b*) breit."

Variable, depending upon the preparation of the specimen.

"3. kaudale genitalpartie: (*a*) nicht abgesetzt, (*b*) durch seitliche Eindrücke abgesetzt."

Variable.

"4. Genitalöffnung: (*a*) terminal, V-Form spitz, (*b*) subterminal, V-Form breit, stumpfwinkelig."

Entirely imaginary, and dependent upon the angle at which the apex of the abdomen happens to be turned to the observer.

"5. Kaudalrand derselben: (*a*) Lippenrand mit Borstenreihe, (*b*) beides fehlend."

Entirely erroneous.

"6. postgenitales Borstenfeld: (*a*) unregelmäszige Reihen, schmal, (*b*) regelmäszige, auf Chitinplatte, breit."

Imaginary. The appearance varies greatly with the angle at which the end of the body is turned to the observer.

"7. Decklappen: (*a*) schmal, (*b*) breit."

Imaginary.

"8. präanales Borstenfeld: (*a*) dicht, (*b*) schütter."

Certain setae in this area are quite definitely fixed and the general pattern is quite constant in a wide range of material, but there is considerable variability in the number of setae. The character is trivial and inconstant.

The genitalia of the male as shown in Figure 325 present no noticeable differences.

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Conclusions.—It thus appears that, while it may be possible to find, even under natural conditions, pure strains in which the typical characteristics that are supposed to define these two forms are clearly developed, it is also possible to find every variation of them. The evidence of Nuttall

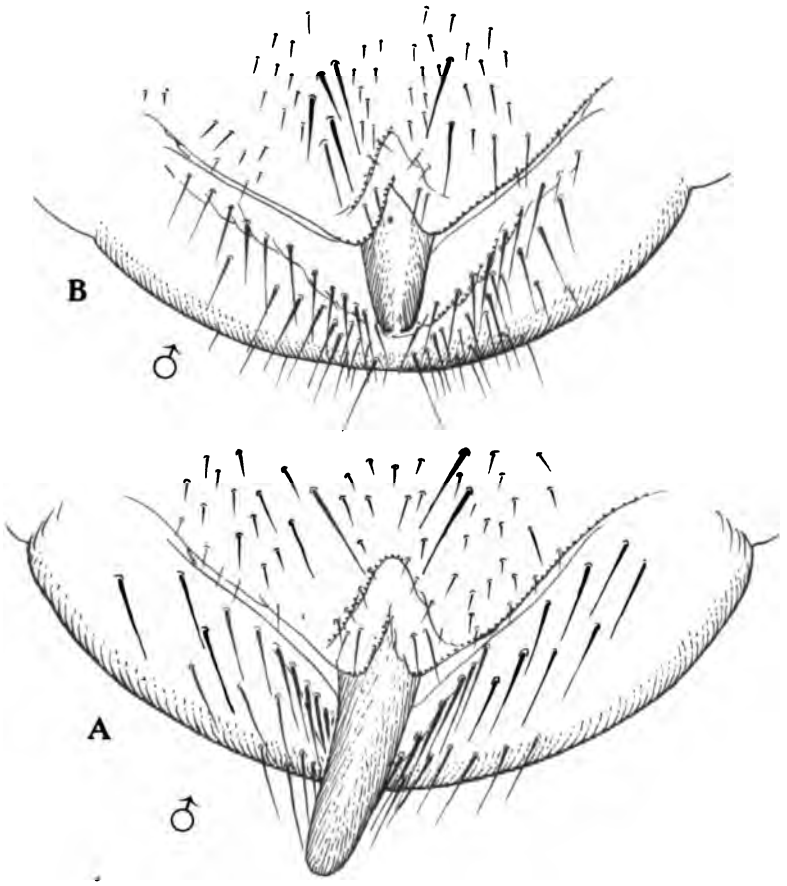

FIG. 324.—*Pediculus humanus* Linnaeus. Dorsal aspect of apex of abdomen of males of: *A*, typical "*capitis*"; and *B*, typical "*corporis*."

that differences in size and color are environmental has already been discussed. He has also presented evidence that certain of the supposed morphological differences fall into the same category. He records (1919, p. 344) the observations of Sikora, who reared specimens in boxes, that an alteration from typical "*capitis*" to typical "*corporis*" was produced. He records also the observation of Howlett that specimens of the former transferred to the body and there reared led to an F_2 generation about 75 per

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cent of which would be called *"corporis"* as far as size and pigmentation were concerned.

He further records observations upon material reared by Bacot: A strain of *"capitis"* started in the laboratory in 1915 were sent alive to Nuttall in 1918. At this time they were "in every morphological detail like *corporis* having lost all the supposedly 'specific' characters of *capitis*."

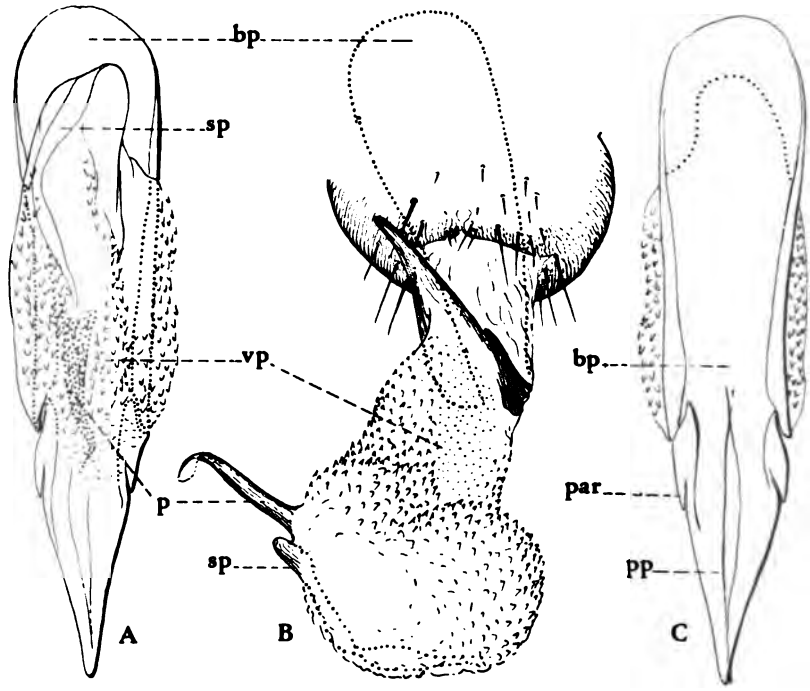

FIG. 325.—*Pediculus humanus* Linnaeus. Genitalia of male: *A*, dorsal aspect; *B*, extruded; *C*, ventral aspect (*bp*, basal plate; *par*, parameres; *pp*, pseudopenis; *p*, penis; *sp*, statumen penis; *vp*, vesicula penis).

Material from this same lot has been examined in the course of this study, it being Nuttall's No. 287. In every respect—antennae, paratergal plates, genitalia of female—these are *"corporis"* as we have described that form from typical material. The only link here lacking is material from the original stock. We would wish to know exactly what the progenitors of this strain were like. However, Bacot was engaged in the study of these insects for an extended period and we may probably accept his conclusions as to the character of his original material.

It is also unfortunate that the reverse experiment, attempting to convert typical *"corporis"* into typical *"capitis,"* has never been recorded.

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Crosses between *"capitis"* and *"corporis"* were found by Bacot to be fertile to at least the third generation. But here a disturbing factor enters. Nuttall and Keilin (1919), dealing with the phenomenon of hermaphroditism in *Pediculus humanus,* definitely connect its occurrence with hybridism between the two forms. One cross, carried through the F_8 generation, gave a total of 12 per cent hermaphrodites out of 970 individuals. Nuttall and Keilin recognize all of this as evidence of a racial difference between the two forms.

It certainly appears to be evidence of genetic incompatibility and thus to throw doubt upon the validity of the conclusions concerning the transformation of one form into another by environmental changes. There are a number of questions as to which an answer is needed.

What was the exact origin of the ancestors of these crosses? It is possible that, while *"capitis"* and *"corporis"* taken, let us say, from a common source in Europe may be merely environmental forms with no genetic difference, *"capitis"* taken from an African Negro would be genetically distinct. It should be noted that Bacot's work was done in Cairo.

Would crosses between *"capitis"* descendants which have been transformed into *"corporis"* by environmental changes show a genetic incompatibility when crossed with other *"corporis"*?

Is there any chromosomal difference between the two races?

Until such questions as these have been answered, some cloud must remain upon the conclusion that the two forms are purely expressions of environmental differences, and a contradiction between the two kinds of experimental evidence thus far adduced remains.

Nevertheless, the bulk of the evidence supports clearly the view that these two forms are merely extremes of a single species; that every combination of and intergradation between their characters exists; that, even if pure lines with an actual genetic difference exist, these are under natural conditions so obscured by genetic recombinations that no sharp distinction between the two extremes can be drawn.

If they are to be nomenclatorially recognized, the name *Pediculus humanus humanus* Linnaeus must be used for the body louse and *Pediculus humanus capitis* de Geer for the head louse. In the opinion here adopted nothing is to be gained by formal recognition of these forms.

PEDICULUS NIGRITARUM Fabricius

Apparently but two authors since the time of Fabricius have attempted to take up this name and apply it to specimens, Fahrenholz having employed it for a single individual and Ewing reviving it for specimens from Negroes in both Africa and the United States.

We may at this point introduce the key devised by Ewing for the recog-

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nition of the five supposed varieties of *Pediculus humanus* occurring in America:

A¹. Over one-half of the body setae arranged into definite transverse rows, those that are not so arranged chiefly setiform; number of setae in ventral row on segment VI of female typically 8; diameter of bulb of thoracic spiracle less than a tenth of a millimeter; macrochaetae of thorax shorter.

B¹. Second and fifth antennal segments each twice as long as broad and segment III broadened distally and distinctly longer than IV.

C¹. Second pair of macrochaetae of thorax longer than the others; macrochaeta III of thorax situated about the diameter of the thoracic spiracle behind the same.

P. (Pediculus) humanus nigritarum Fabricius
P. (Pediculus) humanus corporis de Geer

C². Second pair of macrochaetae of thorax subequal with others; macrochaeta III of thorax situated more than the diameter of thoracic spiracle behind the same.

P. (Pediculus) humanus marginatus Fahrenholz

B². Second and fifth antennal segments each about one and a half times as long as broad and segment III subequal or almost subequal with IV.

P. (Pediculus) humanus americanus Ewing

A². Scarcely half of the body setae arranged into definite transverse rows, those that not so arranged are spine-like or peg-like; number of setae in ventral row on segment VI of female typically 12 (11–13); diameter of spiracle bulb considerably over a tenth of a millimeter.

P. (Pediculus) humanus humanus Linnaeus

It should be noted that Ewing, ignoring earlier fixations of the name *"humanus,"* has here reversed the application of names to head and body louse, his *"humanus humanus"* being *"capitis"* of other authors.

The original description of *P. nigritarum,* already quoted, contains nothing of any value except perhaps the statements that the body is immaculate, the size slightly smaller than that of *P. humanus*—which to Fabricius apparently meant both head and body lice—and the habitat the bodies of Negroes.

As to *P. nigrescens* von Olfers, we may accept the statement of Fahrenholz that it is merely another name for *nigritarum.*

As differences between the body louse of Europeans and the single specimen referred by him to *nigritarum,* Fahrenholz offers the following: "Das Sternum, das gegen das der Kopflaus des Negers gut unterschieden ist, zeigt Textfigur [Fig. 317 *F*]. Die Dorsalseite trägt auf dem letzten Segment des Abdomens ebenfalls das braune Paar Platten, wie das Weibchen der Kopflaus des Negers. Aufgefallen ist mir noch, dasz die einzelnen Fühlerglieder, die bei *Ped. corporis* des Europäers in der grundform lineal erschienen, bei dem vorliegenden Exemplar umgekehrt birnförmig aussehen."

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As for these characters, reference to the series of figures of the sternal plate (Fig. 317) will show the uselessness of such trivial details as those cited by Fahrenholz. The "braune Paar Platten" are present on every female in different degrees of pigmentation.

Ewing, apparently not aware of Fahrenholz' resurrection of this name, employed it for two lots of material from Negroes in Africa and at New Orleans, U.S.A. His figures and description make perfectly clear his understanding of the supposed form.

Material at hand having a bearing upon this supposed subspecies is to be found especially in the lot from Wanyaruanda Negroes, Belgian Congo. In this are specimens which practically duplicate the photographs given by Ewing and which show the supposedly significant characters used in his key. Unfortunately for Ewing's thesis that these lice form a variety peculiar to Negroes, these specimens also practically duplicate typical specimens of European ***humanus!*** We may consider the supposedly distinctive characters cited by Ewing:

1. Over half of the body setae arranged into definite transverse rows.

The specimens at hand vary in this. In some, which are rather sparsely haired, the arrangement in rows is quite distinct; in others which are more hairy, it is less so. A specimen which most closely conforms to Ewing's claim is practically duplicated by a specimen from head of woman, workhouse, Gloucester, England.

2. Number of setae in ventral row on segment VI [apparently meaning segment VII] typically eight.

The number in entirely comparable specimens in the lot from Wanyaruanda Negroes ranges from seven to eleven. Specimens from other sources, which by every criterion are typical *"corporis,"* show the same range, and specimens of typical *"capitis"* from England range from eight to sixteen.

3. Diameter of bulb of thoracic spiracle less than a tenth of a millimeter.

Owing to the fact that it is very difficult to get a precise measurement of these spiracles, this has not been attempted. But drawings, made as carefully as possible, are presented. Compare Figure 316 *C*, from one of these specimens which fall within Ewing's concept of ***nigritarum***, with Figure 316 *F*, from a specimen of *"corporis"* from England, and Figure 316 *E*, from a specimen of *"capitis"* from England. The use of this character is impossible.

4. Macrochaetae of thorax shorter and second pair longer than the others.

Even if a difference exists, it is only rarely that these setae are so flattened down that their true length can be determined.

Compared directly with specimens of typical *"capitis"* and *"corporis,"* these supposed ***nigritarum*** appear darker. But if we compare them with

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the illustration given by Nuttall in *Parasitology* (Vol. 11, Pl. 10, Fig. 1) which illustrates the effect of background upon depth of pigmentation, this difference loses any significance. As concerns both color and form, some of these specimens of *nigritarum* duplicate those in the photograph. Certainly any theory of the presence upon Negroes of a distinctive form of *Pediculus humanus* cannot be based upon Ewing's concept of *Pediculus nigritarum*.

PEDICULUS CAPITIS MACULATUS Fahrenholz

This form was named by Fahrenholz (1915) for the reception of specimens from Hottentot Negroes. In it were later included specimens from Negroes in the Cameroon, Africa, and Paramaribo, Dutch Guiana (Fahrenholz, 1917).

Material from the lot from Paramaribo has been available for examination through the kindness of the Hamburg Museum. In addition to this, part of the specimens from Wanyaruanda Negroes, Lulenga, Belgian Congo; others from the heads of Masai Negroes, Nairobi, Nuttall, No. 257; from the head of negress, Obuasi, South Ashanti, Nuttall, No. 3; and from the head of Sudanese woman, Khartoum, Nuttall, No. 290, have a special bearing upon this form. The Piaget Collection in the British Museum contains specimens from Negroes, Cameroon, which belong to it.

That we have here to do with a rather distinctive and recurring form characteristic of Negroes cannot be denied. It is a small, dark type, of which the female (Plate II) has a distinctively rotund and compact shape so that to the eye it is immediately recognizable.

In establishing the variety, Fahrenholz called attention to the strong sclerotization of all the parts, which is probably the real reason for the distinctive form of the species. He was apparently impressed by the quite unimportant variations in the form of the thoracic sternal plate, the range of which is shown in Figure 317, and by supposed differences in the thumb of the first tibia in the male which are utterly insignificant (Fig. 326, *G* and *L*).

In spite of its distinctive form, actual morphological differences between *maculatus* and European *humanus* are unimportant. The antennae (Fig. 313 *N*) of a specimen from Paramaribo are the shortest observed, but this correlates with the small size. The thoracic spiracles in some of the specimens from Wanyaruanda (Fig. 316 *A*) are extraordinarily large and conspicuous, but this feature does not appear in other specimens of similar form, the spiracle in specimens from Masai Negroes and from Paramaribo (Fig. 316, *B* and *D*) being actually little, if at all, larger than those from European material, although relative to the size of the insects they are larger. The paratergites (Fig. 319 *C*) are quite broad. The gonopophyses

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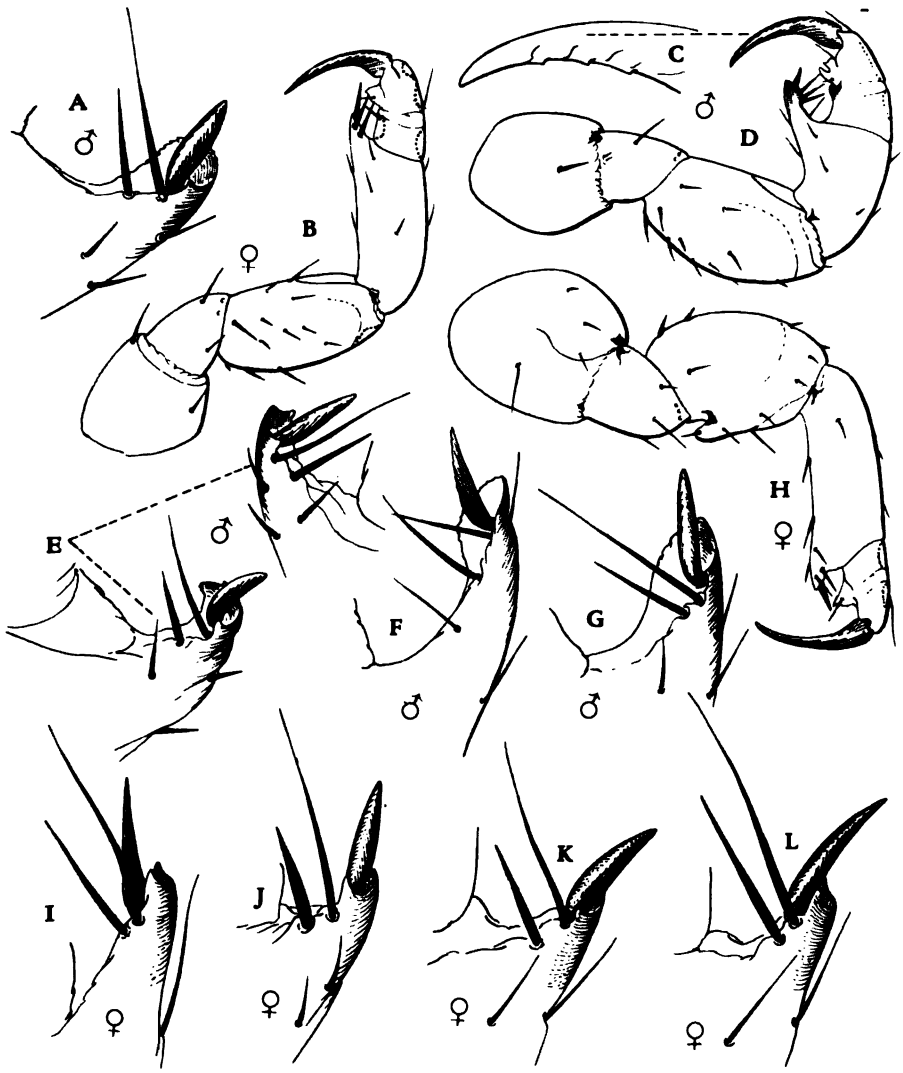

FIG. 326.—*Pediculus humanus* Linnaeus. Thumb of anterior tibia of male: *A*, *"angustus,"* China, specimen determined by Fahrenholz; *E*, right and left of *"americanus,"* from Maya Indian, Xhichel, Yucatán; *F*, typical *"corporis,"* England; *G*, *"maculatus,"* Wanyaruanda Negro, Belgian Congo. Same of female: *I*, typical *"corporis"*; *J*, *"americanus,"* Indian hut, Guatemala; *K*, *"angustus"*; *L*, *"maculatus,"* from Masai Negro, Nairobi. Legs of typical *"corporis"*: *B*, anterior of female; *C*, *D*, male; *H*, posterior of female.

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(Fig. 322 *D*) in some specimens are very acutely pointed, but this appearance is not constant. The tergal plates of the dorsum of the male (Fig. 320 *B*) are heavily pigmented and strongly developed. Apparently as an expression of the general tendency toward heavier sclerotization, some specimens show a slight development of a tergal plate on the second segment, an additional plate on the seventh, and a plate on the eighth where none usually occurs. Likewise, as noted by Fahrenholz, there is a tendency toward the development in both male and female of a small sternal plate on the second abdominal segment. But these features are not constant, even in specimens which are otherwise identical, and it seems clear that they are all associated with the general heavy sclerotization and pigmentation. The head (Fig. 314 *B*), although heavily pigmented, does not differ in proportions from that of typical *"capitis."*

It thus appears that there are no actual structural features which are definitive of this form. Its distinctive shape may very well be due to a certain rigidity caused by the unusual degree of sclerotization. There is some variation in size, specimens of the same appearance ranging from 2.5 to 3.75 mm. in length.

The lot of material from Wanyaruanda Negroes is extremely instructive. Here both this form and another which has previously been considered under the discussion of *P. nigritarum* occur in company. They have been recorded by Bequaert as *P. humanus humanus* (= *capitis*) and *P. humanus corporis*. Between the two extremes every degree of intergradation is to be found in this material, from typical *maculatus* to typical *"corporis."* Furthermore, in some of the other lots of material from Negroes, notably that from head of Sudanese woman, are specimens which are directly intermediate. It is evident that these two forms are either mere extremes of variation or that hybridization occurs.

Consequently, although it seems to the writer that of all the named forms of *Pediculus humanus* this is the most worthy of recognition, and that it may possibly represent a genetically defined type, the name is here rejected owing to the complete intergradation with the more typical forms. It is to be hoped that experimentation with this form may sometime be carried out.

PEDICULUS CAPITIS ANGUSTUS Fahrenholz

This supposed form, which "lebt auf Japanern," is apparently quite imaginary. Fahrenholz offers as its distinguishing features the fact that "in Kanada-Balsam präparierte Exemplare zeigen bei geringer Vergrösserung gelbliche Grundfärbung, die bei dem Thorax und den Beinen in ein helles Braun übergeht, während unter gleichen Bedingungen die Europäerlaus als Grundfarbe ein schmutziges Grau mit zuweilen leicht gelblichbraunem Hauche zeigt." And further: "Das Sternum, von dem bei Euro-

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päerläusen keine Spur zu endecken ist . . . . ," an utterly erroneous statement. Certain other trivial supposed differences are suggested.

On the basis of such statements Ewing has assumed to recognize this form for the reception of two specimens from western China!

The types of this have not been seen in connection with this study, but specimens from "Prov. Fokien, China, G. Siemssen, 1913," identified and recorded by Fahrenholz (1917), received from the Hamburg Museum, may be taken to embody its author's concept of the species. They are rather pale specimens, of the *"capitis"* type, with quite strongly pigmented paratergites (Fig. 307). The antennae (Fig. 313 *E*) are rather large. The thumb of the anterior tibia is shown in Figure 326 *K*, genital plate of the female in Figure 323 *D*, and the gonopophyses in Figure 322 *E*.

There is absolutely nothing to be seen in these specimens which justifies the separation of this form from *Pediculus humanus*.

PEDICULUS CORPORIS MARGINATUS Fahrenholz

"Auch diese Varietät stammt aus Japan." Out of the original description nothing more can be gathered than that this differs from European lice in color as does *angustus*, that the thoracic sternal plate is lacking, which certainly means nothing more than that it could not be seen in the specimens examined, and that the transverse tergal plates of the male are represented mostly by the anterior one of each segment, while "bei den europäischen Kleiderläusen werden solche Querflecken überhaupt nicht angetroffen" —this last statement being entirely false.

The only material available having a bearing on this matter is one lot, Nuttall, No. 45, from Yokohama, Japan, origin not indicated but presumably from Japanese. These are typical *"corporis."*

There seems to be no reason for taking this supposed form seriously.

PEDICULUS HUMANUS CHINENSIS Fahrenholz

The types of this variety were selected from among material from "China, Prov. Fokien (Eingang 8, IX. 1911. G. Siemssen, Futschou)." Two other lots from the same province, collected in 1906 by Siemssen, and one lot in 1913, are recorded by Fahrenholz.

Of this, specimens labeled "Types" have been available, through the kindness of the Hamburg Museum. Other material having a bearing upon it includes Nuttall, No. 179, from Chinese, and Nuttall, No. 180, from pony, all from Szechuen, West China.

Aside from notes on the development of the tergal plates of the abdomen of the male, which are exceedingly variable structures, Fahrenholz states: "Am besten ist die neue Unterart aber durch das Vorhandsein eines deutlichen Sternums charakterisiert." As this structure is present in every

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specimen of *Pediculus* seen in connection with this study, we may disregard the statement. The female is here figured from the type (Fig. 308).

The antennae of the type female (Fig. 313 *A*) are the longest observed, being very slightly longer than those of typical *"corporis"* (Fig. 313 *B*). Nothing appears either in the types or in the material from Szechuen that can justify a separation of this as a distinct form.

PEDICULUS HUMANUS AMERICANUS Ewing

Based by Ewing upon specimens from the heads of American Indian mummies, Surco, Peru, and Ancon, Peru, and Canyon del Muerto, New Mexico, the type being from the first-named locality. He also referred to this form specimens from Indian woman, Cobán, Guatemala, and from the Island of Trinidad without indication of host. Later, Bequaert records specimens under this name, identified by Ewing, from head of a Maya Indian woman, Xhichel, near Peto, Yucatán.

Through the kindness of the American Museum of Natural History it has been possible to examine the type and the specimens from Canyon del Muerto in connection with this study. Also specimens from the Xhichel material and from Indian hut, Santa Emilia, Guatemala, have been received from Dr. Bequaert. Specimens from Tarahumare Indians, northern Mexico, collected by Lumholz, and received many years ago from the Swedish Museum, have been available. One lot from Indian boy, Demerara, British Guiana, also has a bearing upon this form. Other material from Indians, Cerro de Pasco, Peru, and the United States, is not especially pertinent, being typical *"corporis."*

All the specimens from the type and paratype lots being in very poor condition, a figure of the female (Fig. 309) is here presented based upon a specimen from Tarahumare Indians. It may be noted that these Indians even today retain their racial purity firmly, mixing not at all with the whites, and at the time when these specimens were obtained by Lumholz there could have been but little question of the mixing of their louse population with outsiders. These specimens seem to approximate quite closely the concept of *P. humanus americanus.*

In addition to the characters given by Ewing in the key, which has been quoted, he cites other supposedly distinctive characters.

1. Over half the body setae arranged in transverse rows.

In the specimens from Guatemala and from Tarahumare Indians this happens to be true. In Figure 327 are shown careful charts of the setal arrangement on both dorsal and ventral sides of *"capitis,"* from woman, Cambridge, England, and a specimen from Maya woman, Xhichel, Yucatán. It will be noted that the differences are chiefly on the dorsal side. However, a specimen of what can with equal propriety be regarded as *"capitis,"* from

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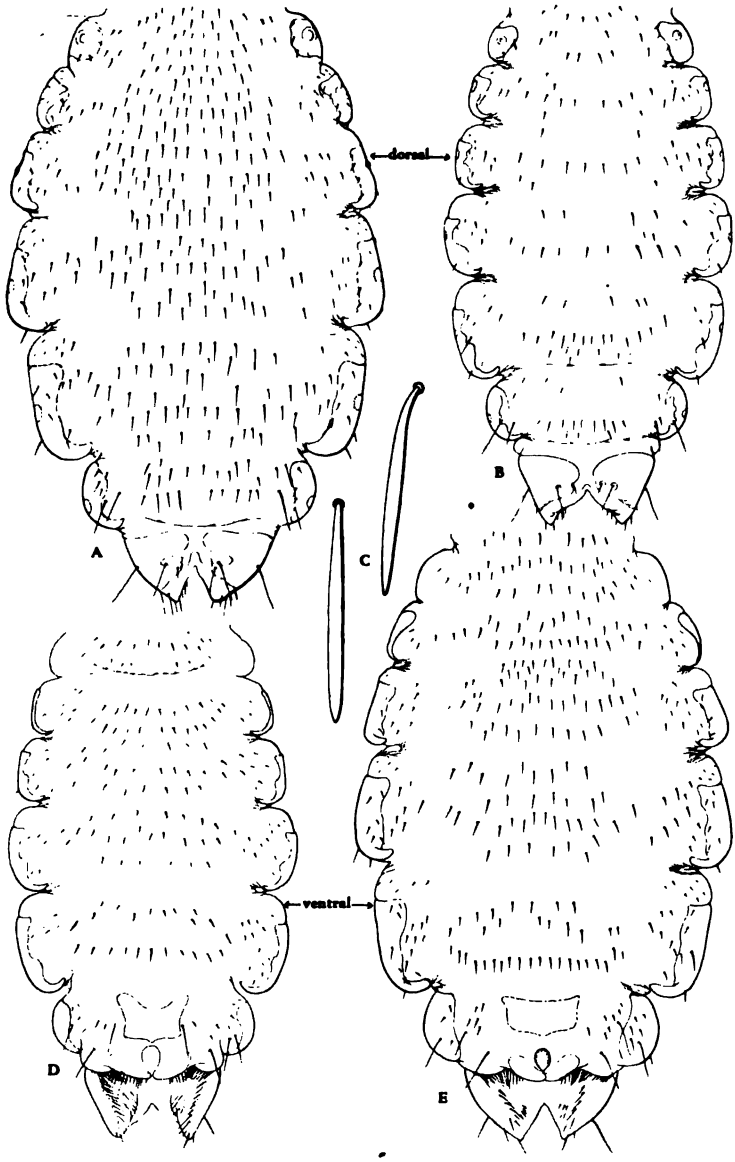

FIG. 327.—*Pediculus humanus* Linnaeus. Arrangement of setae of abdomen: *A*, dorsal side and *E*, ventral side, from typical *"capitis,"* from England; *B*, dorsal side and *D*, ventral side of *"americanus,"* from Maya Indian, Xhichel, Yucatán; *C*, typical setae.

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woman, Gloucester, England, differs in but the smallest degree from that from the Indian and would be referable to *americanus*.

The examination of a long series of specimens shows that the number of abdominal setae, as well as their size and shape, is widely variable in specimens that present no other reason for reference to different forms, and as the number increases the tendency toward the obliteration of regular rows becomes more pronounced, until in the more hirsute specimens it disappears entirely.

2. Number of setae in ventral row of segment VI (VII) of female typically eight, as opposed to twelve.

On this basis a specimen of *"capitis"* from woman, Gloucester, England, others from man's clothes, London, and others from jail, Singapore, to mention merely a few examples, would be referable to *americanus*.

3. Second and fifth antennal segments each about one and a half times as long as broad, and segment III subequal or almost subequal with IV.

The reader need only examine the series of drawings of antennae shown in Figure 313, and reflect upon the effect of a slight change of angle of observation in foreshortening a specimen, or of a slight expansion or contraction of the intersegmental membranes, to perceive the hopelessness of attempting such meticulous differentiation.

4. Thoracic spiracle less than a tenth of a millimeter in diameter.

It is true that in a specimen from Indian hut, Guatemala, the spiracle (Fig. 316 *I*) is the smallest seen, but it is only very slightly smaller than in typical forms (Fig. 316, *E* and *F*) and a specimen from Tarahumare Indians (Fig. 316 *H*) bridges this slight gap.

5. The description states: "Head with poorly developed neck region."

The type specimen has the head strongly retracted into the thorax and somewhat deformed as a result of its preparation, but the neck is distinctly present and well developed, and in the specimen from Maya Indian, not to mention the others, is typical of *"capitis."*

6. The setae on the thumb of tibia I of the male are supposed to be distinctive. Compare Figure 326 *E*, showing the thumb on opposite sides of the body of a male from Xhichel, with that of a series from other sources. And bear in mind that a slight rolling of this thumb will disturb the apparent relationships of the setae.

The conclusion is that this supposed form has no more justification than have any of the others which have been discussed.

PEDICULUS CONSOBRINUS Piaget

This supposed species was described from specimens from *Ateles pentadactylus*, presumably from a zoölogical garden. The name has been taken up by Ewing (1926) and utilized for lice from New World monkeys.

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A single female remains in the Piaget Collection at the British Museum. This specimen was remounted and examined and re-examined by the present writer. It is a perfectly typical specimen of *Pediculus humanus,* of the *"capitis"* type. Owing to the fact that it has been an exceedingly disturbing element in the study of this genus, it is here figured (Fig. 310); the antenna is shown in Figure 313 *I*.

PEDICULUS ASSIMILIS Fahrenholz (= OBLONGUS Fahrenholz)

Described from specimens from *Hylobates syndactylus,* Berlin Zoölogical Garden. Through the kindness of the Berlin Museum it has been possible to see two female specimens, one labeled as from *Hylobates syndactylus* and the other as from gibbon, determined by Fahrenholz but not indicated as types.

The species is here figured (Fig. 311). There is not, it may safely be asserted, a single word in the original description of this species which justifies its recognition. Fahrenholz remarks: "Wie die Beschreibung beweist, ist es wirklich nicht leicht, viele markante Unterscheidungsmerkmale anzugeben." He insists, however, that the total picture presented permits "kein Zweifel" to arise.

In the light of an examination of the specimens recorded, we may agree that no doubt should arise. It is perfectly typical *Pediculus humanus.*

PEDICULUS FRIEDENTHALI Fahrenholz

Recorded from *Hylobates mülleri,* without indication of locality. Unfortunately, specimens of this have not been available. The description presents absolutely nothing which justifies the separation of this species from *P. humanus,* nor is any difference indicated in the figures. No hesitation is here felt in expressing the opinion that it is merely *P. humanus.*

GENERAL CONCLUSIONS

Thus far in dealing with these supposed forms, only material immediately pertinent to the evaluation of each has been admitted. But if we take into consideration the lice at hand from Eskimos, Hindus, Arabs, and other sources listed in the account of material examined, it becomes increasingly evident that no lines can be drawn. In the whole range, excepting only the Negro-infesting *maculatus,* there appears no solid ground for the recognition of any of the names that have been proposed.

The whole assemblage, in the opinion here adopted, constitutes a single species in the sense that has been developed in the prefatory remarks. That any subspecies peculiar to any one of the races of man, other than *maculatus* from Negroes, can be demonstrated to exist is in the opinion here developed entirely untenable. To announce, as Ewing has done, on the basis

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of an examination of a few specimens—note that his description of *angustus*, the characteristic louse of the yellow race, was based upon two males!—that pure races of head lice originally existed on the "white, black, red and yellow races of man living in their original geographic range," and that "the pure races of these head lice should be regarded as distinct varieties, for they differ in definite morphological characters," indicates a failure to appreciate the fundamentals of sound systematic work.

That genetic differences in the members of this vast assemblage may occur seems almost axiomatic, considering the enormous range of the species and its occurrence upon hosts of very considerable genetic separation and considering the possibility of the derivation of part of the present-day louse fauna of man from long-vanished species of the genus *Homo*. That these differences may crystallize out into pure lines at times is entirely probable. That the whole situation is complicated by environmental factors seems definitely proved by the work of Nuttall. That the whole assemblage of *Pediculi* upon man forms a continuously linked genetic complex seems clear. That *Pediculus humanus* may at times establish itself upon other Primates which have been in contact with man seems definite.

These are the indications which may be seen in the evidence now at hand. But we have gone about as far as we can on the basis of the conventional methods of the systematist. It remains for extensive experimental work to carry farther the investigation of the problem which has been set.

We may even suggest something of what that work should be: confirmatory experiments upon the work already done as to the effect of environment upon pigmentation; experiments upon the transformation of positively determined typical *Pediculus humanus capitis* and *P. humanus corporis*, the one into the other *and back again*, with particular reference to morphological modifications; concentration especially upon the small, dark, rotund form which appears to occur characteristically upon Negroes, in order to determine whether it is a fixed genetic entity or a product of environmental factors; crosses of these and other extreme forms; cytological studies in search of a possible basis for the origin of the abnormalities observed by Nuttall; and the extension of these studies to include the next species now to be examined.

2. Pediculus mjöbergi Ferris

FIGS. 318 *E*, 319 *E*, 322 *F*, 323 *I*, 328, 329, 330, 331, 332

1877. ? *Pediculus quadrumanus* Murray, *Economic Entomology, Aptera*, p. 3. (From captive *Ateles* sp. Unrecognizable.)

1910. *Pediculus affinis* Mjöberg, *Arkiv för Zoologi*, 6: 169–171, 258; text figs. 85, 151; pl. 5, fig. 8. (Not *Pediculus affinis* Burmeister.)

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1913. *Pediculus lobatus* Fahrenholz, *Zoologischer Anzeiger,* 41: 373. (Without description.)

1916. *Pediculus mjöbergi* Ferris, "A Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 136. (New name for *P. affinis* Mjöberg. Date of issue, May.)

1916. *Pediculus lobatus* Fahrenholz, *Archiv für Naturgeschichte,* Abt. A, 81: 11: 16–18; pl., figs. 6, 7. (From *Ateles "rellerosus,"* Berlin Zoölogical Garden. Definitive description, date of issue, August.)

1916. *Pediculus lobatus* Fahrenholz, *Zoologischer Anzeiger,* 48: 89. (Intended as a preliminary description to precede the definitive description, but date of issue indicated as October.)

1919. *Pediculus humanus* race *capitis* de Geer, Nuttall, *Parasitology,* 11: 337, 340. (Erroneously rejects the species.)

1920. *Pediculus humanus* race *capitis* de Geer, Nuttall, *ibid.,* 12: 142. (Maintains the same opinion.)

1926. *Pediculus lobatus* Fahrenholz, Ewing, *Proceedings United States National Museum,* 68: 8–9; pl. 2, fig. 5. (Records the species, on the basis of a single immature female, from *Ateles pan,* from Guatemala.)

1926. *Pediculus atelophilus* Ewing, *ibid.,* 68: 9; text figs. 4 *A,* 5.

1926. *Pediculus consobrinus* Piaget, Ewing, *ibid.,* 68: 10–13; pl. 1, fig. 1; text figs. 2, 3 *D.* (From *Ateles paniscus,* Bolivia. Misidentification.)

1926. *Pediculus chapini* Ewing, *ibid.,* 68: 13–15; pl. 1, figs. 3, 4; text figs. 2, 4 *B,* 5. (From *Ateles ater,* Washington Zoölogical Park.)

1929. *Pediculus consobrinus* Piaget, Ewing, *Manual of External Parasites,* fig. 72. (Figured, without discussion.)

1931. *Pediculus atelophilus* Ewing, Hinman, *Parasitology,* 23: 488; 3 figs. (Recorded from specimens from captive *Ateles geoffroyi.* Describes adult female, first-stage nymph, and egg.)

PREVIOUS RECORDS. Recorded by Mjöberg from *"Ateles* ape" in a menagerie; by Fahrenholz from *Ateles "rellerosus"* (= *pan*), Berlin Zoölogical Garden; by Ewing, as *P. lobatus,* from *Ateles pan* taken in Guatemala; as *P. atelophilus,* from *Ateles geoffroyi,* Washington Zoölogical Park; as *P. consobrinus,* from *Ateles paniscus* collected in Bolivia and Washington Zoölogical Park, and from *Lenotocebus nigricollis,* Washington Zoölogical Park; and as *P. chapini,* from *Ateles ater,* Washington Zoölogical Park; by Hinman as *P. atelophilus* (determined by Ewing), from *Ateles geoffroyi,* from Panama, but captive at New Orleans.

SPECIMENS EXAMINED. The types of *Pediculus lobatus* Fahrenholz received as a loan from the Berlin Museum. A single female "from *Cebus hypoleucus,* found on skin in Museum," and males, females, and nymphs from *Ateles paniscus,* London Zoölogical Gardens, all in the British Museum. Two males from captive *Ateles* sp., Mexico City, Dr. Valadez, Stanford Collection. Many males, females, and nymphs of all stages collected by Mr. L. H. Dunn, of the Gorgas Memorial Laboratory, Panama, from captive monkeys, and by him most generously made available for this study. The hosts are as follows: "black spider monkey," *Ateles dariensis,* seven

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lots from Panama City, Darien Province, and Bayano River District; "red spider monkey," *Ateles geoffroyi,* three lots from Panama City, Chiriqui

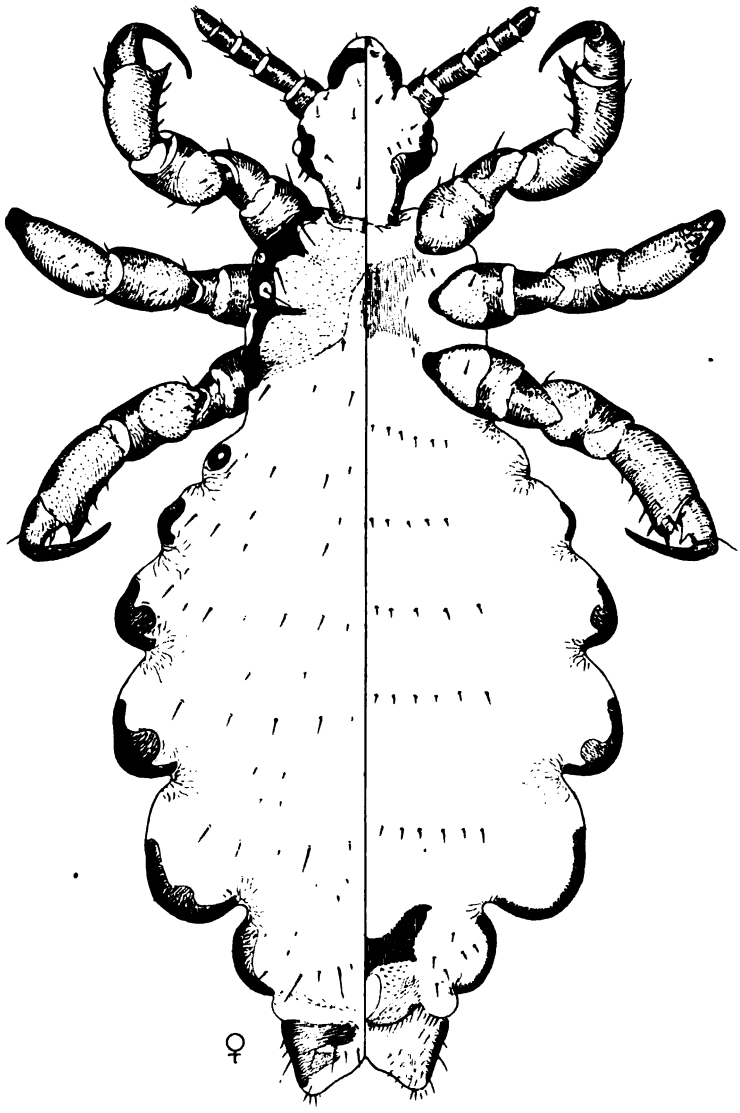

FIG. 328.—*Pediculus mjöbergi* Ferris. Female, from *Ateles dariensis,* Panama.

Province, and Darien Province, Panama; "black howler monkey," *Alouatta palliata inconsonans,* from Los Santos Province; "white faced monkey,"

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Cebus capucinus capucinus, Darien Province; "ring tailed monkey," Bronx Zoölogical Park, American Museum of Natural History. Without indication of host, Bogota, Colombia, Nuttall, No. 285.

FEMALE (Figs. 328, 330). Length attaining 2.75 mm. Differing from *Pediculus humanus* most significantly in the form of the paratergal plates (Figs. 318 *E,* 319 *E*), those of the fifth and sometimes the seventh segment bearing a marginal lobe on both dorsal and ventral sides. Abdominal setae very inconspicuous, partly because of an actual reduction in numbers and also because of a reduction in size, many of them being extremely minute. Sternal plate of the thorax (Fig. 331 *G*) tending to be shorter and broader than in *P. humanus.* Abdomen of a rather characteristic shape, unexpanded specimens having the seventh abdominal segment somewhat broader than the sixth (Fig. 330) and expanded specimens having the abdomen deeply lobed, the lobes more rounded than in typical *P. humanus.* Genital plate (Fig. 323 *I*) resembling that of *humanus;* gonopophyses (Fig. 322 *F*) and genital region showing no sharply characteristic features. Antennae (Fig. 332 *F*) tending to be somewhat larger and stouter than in *P. humanus.* Posterior femora (Fig. 332 *E*) with a well-developed copulatory tubercle.

MALE (Fig. 329). Length about 2.00 mm. Differing from *Pediculus humanus,* as does the female, in regard to the paratergal plates and thoracic sternal plate. Tergal plates of the dorsum of abdomen (Fig. 331, *L–Q*) tending to be much reduced, at times practically lacking. Genital plate (Fig. 331, *H–K*) tending to be smaller than in *humanus,* and at times longitudinally divided into two plates. Genitalia and apex of the abdomen showing no noticeable difference from those of *humanus.*

DISCUSSION

Pediculus quadrumanus Murray was the first species of this genus to be recorded from any of the Cebidae and there is a strong probability that it is the same as the species at hand. However, it is entirely unrecognizable from the original description and figure, and the fact that specimens of indubitable *P. humanus* have been taken from monkeys of this family increases the uncertainty. The species should be dropped as unrecognizable, since inquiry made by Mr. Gordon Thompson of the British Museum indicates that the types are no longer in existence.

Pediculus consobrinus Piaget, as has been shown, is clearly a synonym of *P. humanus. P. affinis* Mjöberg is therefore the first species credited to New World monkeys which needs to be considered. The name *affinis,* being preoccupied, was replaced by *P. mjöbergi* Ferris in 1916. In the meantime, Fahrenholz had in 1913 published the name *Pediculus lobatus* for lice from an *Ateles,* but the name was unaccompanied by even the brief-

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est description and remained a *nomen nudum* until the formal description appeared in 1916. Unfortunately, the name *mjöbergi* has priority of some three months over the much more appropriate name *lobatus*.

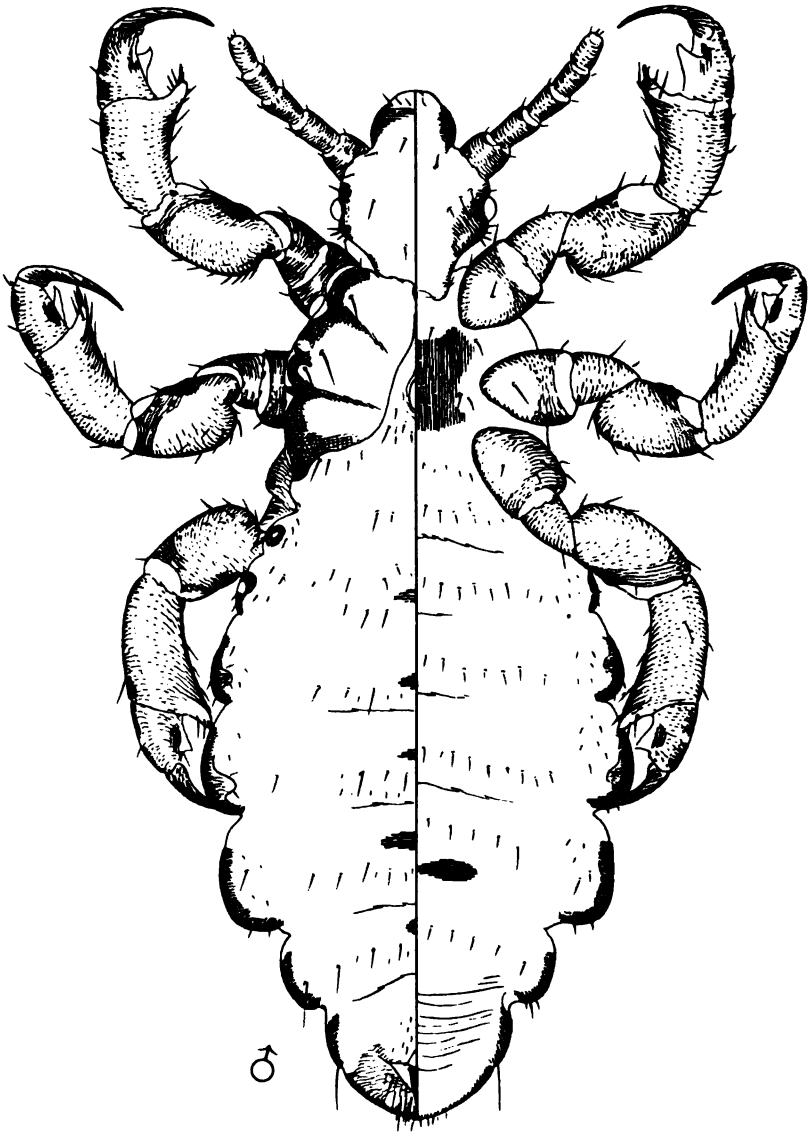

FIG. 329.—*Pediculus mjöbergi* Ferris. Male, from *Ateles dariensis*, Panama.

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The original description of *Pediculus mjöbergi* (as *affinis*) contains scarcely a word which will permit the recognition of the species, but the accompanying illustrations, while very deficient, indicate a strong probability that Mjöberg actually had the species which is here credited with this name. The illustration of the male, given by Mjöberg, seems decisive.

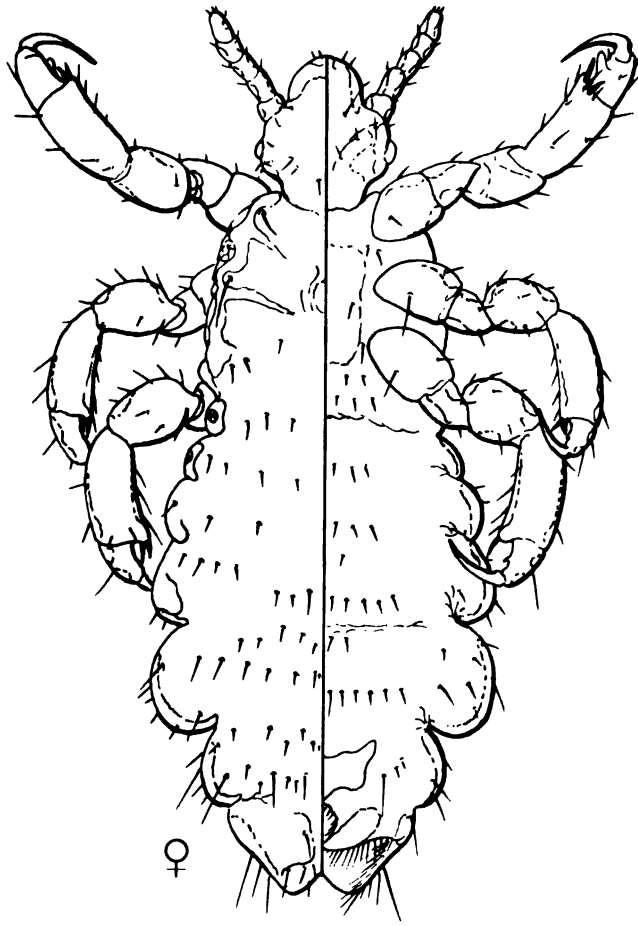

FIG. 330.—*Pediculus mjöbergi* Ferris. Female, from the type of *P. lobatus* Fahrenholz, showing the characteristic form of a contracted specimen.

Freund (1926) recorded specimens of *Pediculus* from *Ateles ater*, Leipzig Zoölogical Garden, utilizing the name "*P. capitis* forma *atelis*" for them. Some question may arise as to whether he was actually proposing a formal scientific name. Nor is it possible to determine from his description what he actually had, the supposed differences in the caudal extremity of the

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male being utterly trivial and he himself remarking that "es sich um *Pediculus capitis* des Menschen handelt, die nur im männlichen Geschlecht eine mäszige Abweichung zeigt." It would appear that the name *"atelis,"* actually validly proposed, is a synonym of either *P. humanus* or *P. mjöbergi*. On a theory of probabilities it may be placed under the latter.

Ewing (1926) assumed to recognize *Pediculus lobatus* Fahrenholz on the basis of "a single female not yet emerged from her nymphal skin." He also assumed to recognize *P. consobrinus* Piaget, of which he placed *P. mjöbergi* as a synonym, and named as new *P. atelophilus*—based upon a single male specimen—and *P. chapini,* all from various species of *Ateles.*

On the basis of the various published descriptions of lice from New World monkeys up to the time of this paper by Ewing, it could not have been asserted with any security that these monkeys harbor lice distinct from those of man. Upon the basis of these descriptions Nuttall (1920) was entirely justified in rejecting all the names that had been proposed. However, it is now perfectly clear that there is upon these monkeys at least one species which must, on morphological grounds, be regarded as distinct from *Pediculus humanus,* even though its existence is difficult to explain and presents a strange problem of distribution.

But that there are actually four such species, as maintained by Ewing, is, in the opinion here adopted, an entirely untenable view. We may proceed to an examination of the bases for these supposed species. Ewing has presented the following key:

A¹. Segment VI (here held to be segment VII) of abdomen considerably broader and longer than V (VI); pleural plate V (VI) about one and a half times as long as IV (V). *P. lobatus* Fahrenholz

A². Segment VI (VII) of abdomen not so broad as V (VI) and only slightly longer.

B¹. The inner anterior and single posterior accessory spines of tibial thumb, or protuberance, of legs II and III equidistant from the terminal spine and neither situated in crotch of tibia; pleural plate I (segment 3) very small and not much larger than the enclosed stigmal foramen. *P. atelophilus* Ewing

B². The inner anterior accessory spine of tibial thumb of legs II and III situated almost in crotch of tibia, while posterior accessory spine is situated contiguous with the chief, or terminal, spine; pleural plate I (segment 3) much larger, squarish, and over twice the width of enclosed stigmal foramen.

C¹. Diameter of bulb of thoracic spiracle about 0.09 mm.; posterior accessory spine of tibial thumbs II and III much more slender than the inner anterior accessory spine. *P. consobrinus* Piaget

C². Diameter of bulb of thoracic spiracle about 0.06 mm.; posterior accessory spine of tibial thumbs II and III subequal with the inner anterior accessory spine. *P. chapini* Ewing

The form of the abdomen.—The types of *P. lobatus* Fahrenholz, as well as numerous other specimens, show the supposedly distinctive form of the

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abdomen, having the seventh segment broader than the sixth. In immature forms this appearance is normal, but in adults it is due entirely to a shrunken condition of the body. It has been demonstrated conclusively that an adult specimen showing this appearance, if boiled in caustic potash in the manner commonly followed in preparing cleared specimens (a method apparently never used by Fahrenholz), will expand and assume the form characteristic of full-fed or gravid specimens in which the sixth segment is broader than the seventh.

The supposed distinction between this species and the others, cited in the key quoted above, is entirely illusory.

The thoracic spiracles.—Measurements differing in the order of 0.06 mm. as against 0.09 mm. are offered as diagnostic of *P. "consobrinus"* and *P. chapini*. In the first place, such a difference might be expected to come within the possible limits of normal variation; and, in the second place, it is so slight as probably to be exceeded by the normal error in measurement in many cases. Measurements of specimens at hand range from 0.038 to 0.056 mm. in specimens which appear in every respect to be the same species, with a variation from 0.057 to 0.047 mm. on opposite sides of the same specimen. Such a character must be dismissed from serious consideration.

Paratergal plates.—Ewing, in the quoted key and in descriptions, has utilized the form of the paratergal plates of the third abdominal segment, these being the first pair. In Figure 331, *A–F,* are shown a series of these plates from males, all from the same lot off *Ateles dariensis,* except Figure 331 *D,* which is from *Ateles geoffroyi*. In Figure 331, *A* and *C* are from opposite sides of the same specimen. It is evident from these figures that reliance upon this structure for the separation of species is impossible. In the female the members of this pair of plates are usually somewhat of the shape of Figure 331 *F,* and average larger than in the male, but show much the same range of variation.

The form of the other plates likewise is quite variable, especially in regard to the development of the secondary lobes on the plates of segments V–VII. In some specimens the plates of segment VII are quite distinctly lobed, in others not at all so; but this difference may occur as between opposite sides of the same specimen or as between specimens from the same lot.

It is evident that these details of the form of the paratergal plates may not be relied upon for the recognition of species.

Tergal plates of the male.—The tergal plates of the male are extremely variable, ranging through such a series as shown in Figure 331, *L–Q,* which is taken from specimens in the same lot, off *Ateles dariensis*. It is evident that these may not be used for the separation of species.

Genital plate of the male.—The genital plate of the male is extremely

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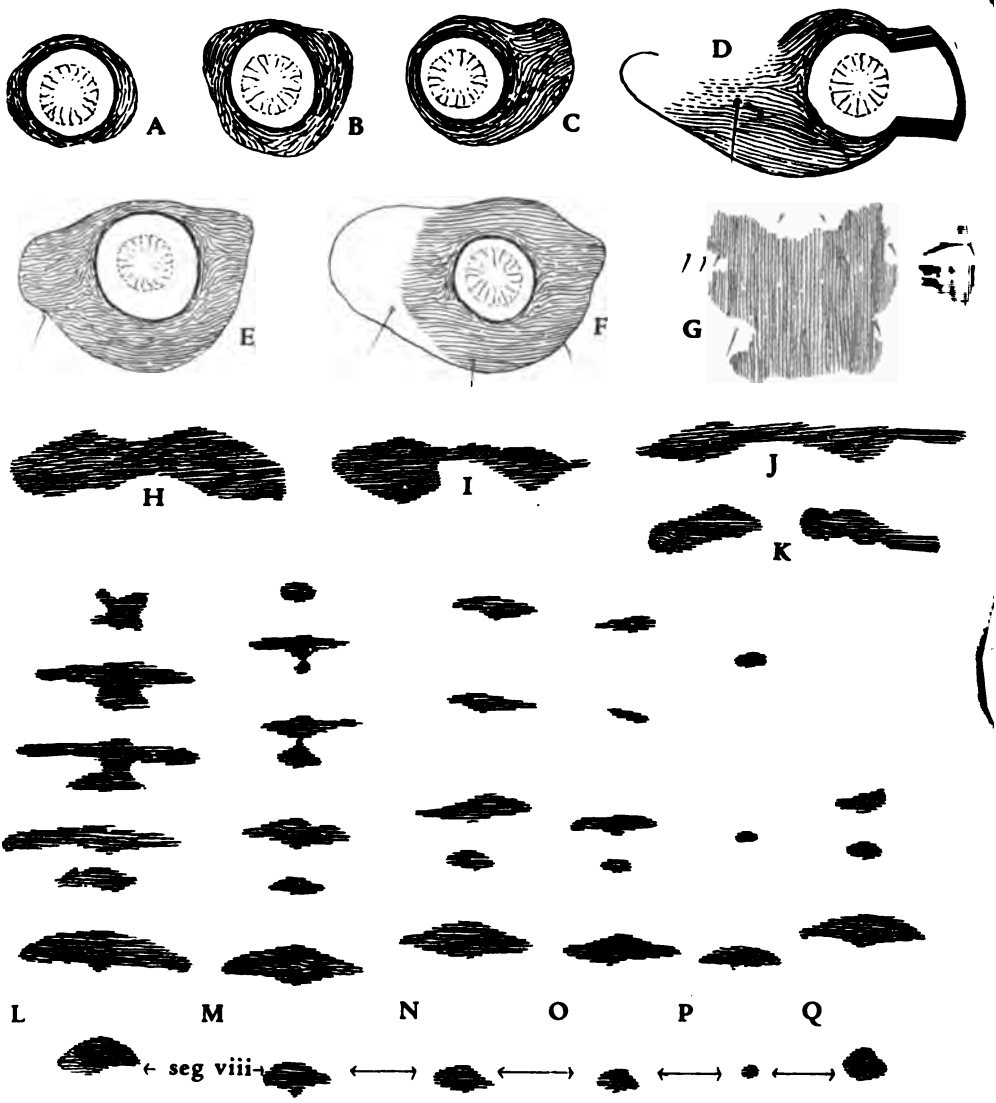

FIG. 331.—*Pediculus mjöbergi* Ferris. *A–F*, variations in first abdominal paratergal plate of male, all from *Ateles dariensis* (except *D*, from *Ateles geoffroyi*), *A* and *C* being from opposite sides of the same specimen. *G*, thoracic sternal plate, characteristic form. *H–K*, variations in form of genital plate of male, all from specimens from *Ateles dariensis*. *L–Q*, variations in abdominal tergal plates of the male, all specimens from *Ateles dariensis*.

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variable, as shown in Figure 331, *H–K*. No specimens have been seen in which it is entirely lacking, but it is quite commonly divided into two plates.

Genitalia of the female.—The genitalia of the female are comparatively stable, the genital plate being of the form shown in Figure 323 *I* and the gonopophyses as shown in Figure 322 *F*.

The setae of the tibial thumb.—The differences cited by Ewing as separating *P. atelophilus* from *P. consobrinus* and *P. chapini* are at the best exceedingly minute, and it should be noted that but a single male specimen of the first-named species was available to him. In Figure 332, *A–D*, are shown comparisons of the tibial thumbs of various specimens which will indicate the range of form. To attempt to separate species on the basis of such characters is, in the opinion here maintained, entirely unjustified.

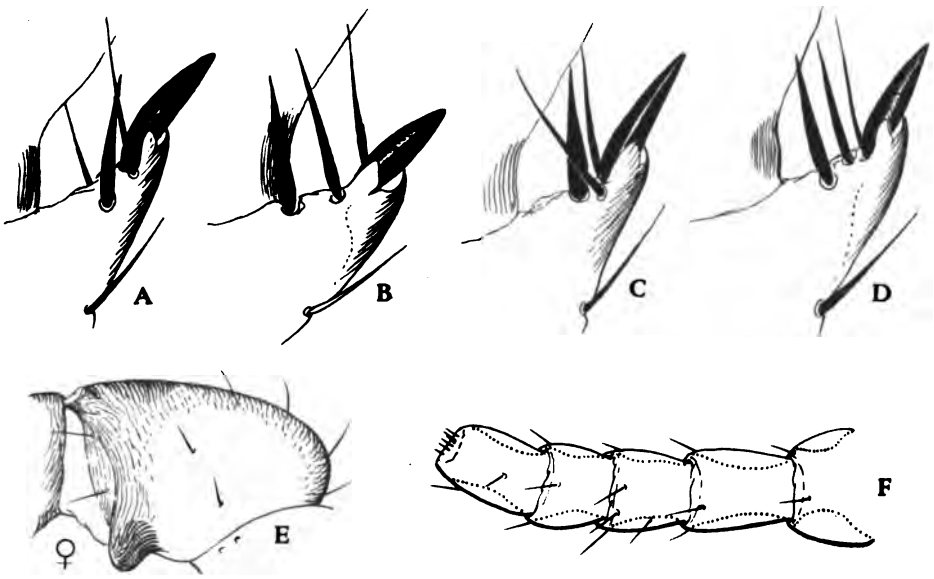

FIG. 332.—*Pediculus mjöbergi* Ferris. *A–D*, variations in chaetotaxy of tibial thumb of second leg of female, all specimens from *Ateles dariensis* (except *C*, from *Cebus capucinus*, Panama). *E*, posterior femur of female. *F*, antenna of female from type of *P. lobatus*.

COMPARISON WITH PEDICULUS HUMANUS

It is certainly no longer possible to maintain the opinion that all records of *Pediculi* on members of the family Cebidae have to do with *Pediculus humanus* which has strayed from man. But to attempt the segregation of these monkey-infesting lice into a subgenus of their own, as has been done by Ewing, is seriously to overemphasize their degree of difference from the

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lice of man. Actually the differences between the two species, considering the enormous range of variation found in *P. humanus,* are not great, and were it not for the apparent stability and persistence of the morphological characteristics shown by specimens from monkeys they might almost be considered as merely further extreme variants.

The total picture presented by them, however, is so consistent as to make it impossible to hold such a view. Nevertheless, attention should be called to an apparent intermediate condition of the most distinctive character of *P. mjöbergi,* that of the lobing of the paratergal plates. In the specimens from Maya Indian, Xhichel, Yucatán; "Indian hut," Guatemala; and Tarahumare Indians, Mexico, there is a *slight and variable* indication of these lobes, although these specimens are in other respects quite typical *Pediculus humanus.*

It will immediately appear that these specimens are all of New World origin, and were it not for two other lots some justification might be found in them for supporting the claims of *Pediculus humanus americanus* to recognition. But unfortunately for any such conclusion, in a lot from native woman, Hakahetau, Marquesas Islands, and another lot from native children, Hitiaa, Tahiti, the character is equally well developed. In Figure 319 *D* are shown the plates from specimens from the Marquesas. In this lot the development of the lobes in immature specimens is practically as strong as in the corresponding stages of specimens from monkeys!

In the light of these specimens, especially those from the South Sea Islands, we cannot feel so sure of the absolutely distinct status of *Pediculus mjöbergi.* But the problems which this species presents are many. The occurrence of any species of *Pediculus* upon New World monkeys is unreasonable from any point of view, for mammalogists are agreed that these monkeys have but little to do with the remainder of the Primates. The problem of the origin of *Pediculus mjöbergi* cannot be discussed here, but it may be pointed out as one of the most interesting of those connected with the genus *Pediculus* and awaiting solution. It should be noted here, as a contribution toward the further obscuring of this problem, that there exists no clear record of this species ever having been taken from monkeys that have not been in contact with man. Mr. L. H. Dunn, from whom most of the material here recorded was received, states that the examination of more than a hundred monkeys killed in the wild has revealed no lice. All of his specimens came from hosts which had been in captivity for some time. And yet to assume that they acquired their parasites from man is to ascribe to the influence of environment a capacity for the immediate modification of morphology that cannot be justified even as an extension of the experimental evidence adduced by Nuttall and cited in the discussion of *Pediculus humanus.* Again we await experimental evidence.

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3. Pediculus schäffi Fahrenholz

FIGS. 322 *H*, 333, 334

1910. *Pediculus schäffi* Fahrenholz, *Jahresbericht des Niedersachsischen zoologischen Vereins zu Hannover*, 1: 57–65; pl. 1, figs. 1, 3; pl. 3, figs. 1, 2, 4, 5; pl. 4, figs. 2, 6. (The definitive description.)

1910. *Pediculus schäffi* Fahrenholz, *Zoologischer Anzeiger*, 35: 714. (A preliminary diagnosis, apparently intended to precede the first reference.)

1915. *Pediculus schäffi* Fahrenholz, Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, 81: 11: 1. (Describes the male.)

1916. *Pediculus schäffi* Fahrenholz, Ferris, "A Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 137. (Lists in catalogue.)

1919. *Pediculus humanus* race *schäffi* Fahrenholz, Nuttall, *Parasitology*, 11: 336–337. (Reduces to status of a possible race of *humanus*.)

1920. *Pediculus humanus* race *schäffi* Fahrenholz, Nuttall, *ibid.*, 12: 142. (Maintains his previously expressed opinion.)

1932. *Pediculus* (*Paenipediculus*) *simiae* Ewing, *Proceedings Biological Society Washington*, 45: 117. (Describes as new species.)

1933. *Pediculus* (*Paenipediculus*) *schäffi* Fahrenholz, *ibid.*, 46: 167. (Discussion of validity and subgeneric position.)

1933. *Pediculus* (*Paenipediculus*) *simiae* Ewing, Ewing, *ibid.*, 46: 168; text fig. 2*c*. (Information on egg and structure of nymph.)

PREVIOUS RECORDS. Recorded by Fahrenholz from a chimpanzee, *Pan* (= *Simia*) *troglodytes*, Zoölogical Gardens, Hanover, Germany. Recorded by Ewing from chimpanzee, London Zoölogical Gardens.

SPECIMENS EXAMINED. Two females in the British Museum, labeled "Monkey, pres. by Mr. A. J. E. Terzi," which it is understood came from a chimpanzee. Two females, received as a loan from the British Museum, labeled as from "Chimpanzee, Gold Coast, zoo. Gdns., London, VII/1932," and evidently from the same source as those upon which the description of *P. simiae* Ewing was based.

FEMALE (Fig. 333). Length 3.00 mm. An elongate, slender species characterized especially by the lack of lateral lobing of the abdomen anterior to the morphologically sixth (apparent fourth) segment of the abdomen and by the deep lobing of the sixth and seventh segments.

Head of the form normal to the genus, constricted into a short neck. Antennae relatively stout. Thorax broader than long, narrowing but little anteriorly and with the head received into a quite marked emargination, the anterior lateral angles of the thorax forming quite pronounced shoulders. Sternal plate not evident in the available specimens. Legs relatively large and slender, the first pair slightly longer and heavier than the others; coxae of the middle legs with a distinct, thumb-like process; posterior femora lacking the copulatory tubercle that is present in the other species of the genus.

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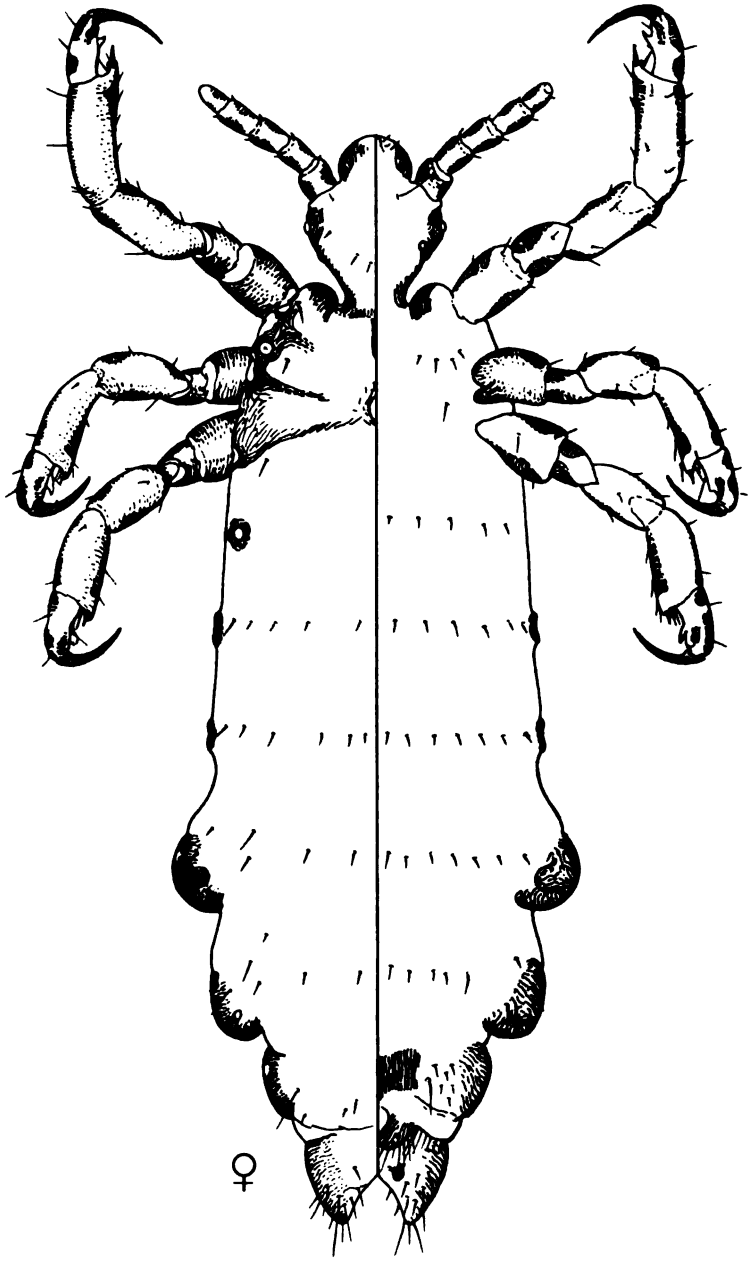

FIG. 333.—*Pediculus schäffi* Fahrenholz. Female, from specimen in the British Museum.

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Abdomen from its base to the anterior margin of the morphologically sixth (apparent fourth) segment practically no wider than the thorax and without lateral lobes, the paratergites of these segments being merely small, sclerotic rings surrounding the spiracle; sixth and seventh segments with the lateral margins produced into large, rounded lobes, capped by the large, strongly sclerotized paratergal plates, each plate (Fig. 334 *A*) with a distinct lobe on both dorsal and ventral sides; eighth segment less strongly lobed and the paratergites without lobes. Gonopophyses (Fig. 322 *H*) short, and very bluntly rounded, but very faintly sclerotic, fringed with but few setae; genital region (Fig. 334 *B*) otherwise as in *P. humanus*. Abdominal setae very small, few, arranged in single rows on each segment as far as may be determined from the material at hand.

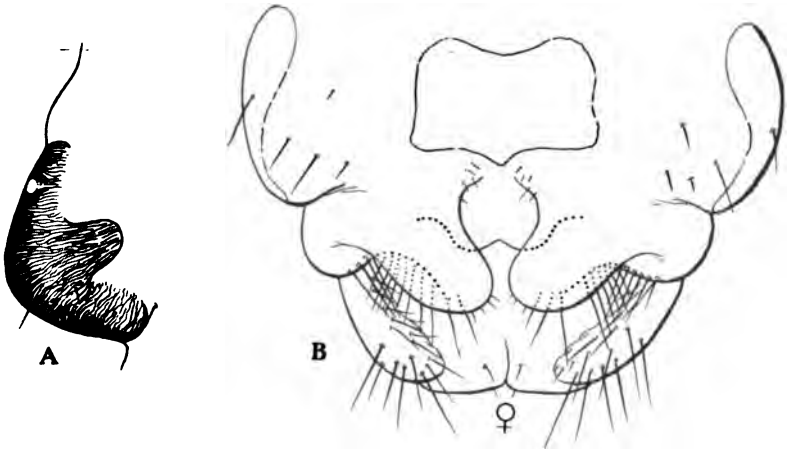

FIG. 334.—*Pediculus schäffi* Fahrenholz. *A*, paratergal plate of sixth abdominal segment of female. *B*, genital region of female.

MALE. Not seen in connection with this work. The essential portion of Fahrenholz' description of it is as follows: "Die Beine sind schlank und unter sich nach Grösze und Bauart gleich. Dies ist insofern sehr auffällig, weil die auf dem Menschen lebenden Pediculi an den ersten Beinpaaren einen ausgeprägten Sexualdimorphismus aufweisen. Am 1. Gliede des 2. Beines hat auch das Männchen den vom Weibchen erwähnten Chitinfortsatz. Das Abdomen läszt in der vorderen Hälfte eine Segmentierung kaum erkennen; die auch beim Weibchen durch starke seitliche Fortsätze ausgezeichneten hinteren Segmente zeigen beim Männchen dasselbe Bild. Nur das Endglied trägt in der Nähe der dorsal gelegenen Geschlechtsöffnung zahlreiche feine Borsten. Sonst bemerkt man am Abdomen nur auf den drei vorletzten Segmenten je eine Querzeile kleiner Borsten."

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NOTES.—Although it has not been possible to see the types of *P. schäffi*, the original description and figures are sufficient to demonstrate that there is no justification for the separation from it of *P. simiae*. No basis for this separation is offered by the author of the latter species, and with specimens from the type lot available, together with the improbability that two very closely related species would occur upon the same host, no special reason for attempting to maintain the two appears. It is clear that Nuttall's reduction of *P. schäffi* to the position of a race of *P. humanus* was unjustified and that the species is beautifully distinct.

Ewing has utilized this species as the type of a subgenus, *Paenipediculus*. Whether or not such an arrangement is desirable is a matter of opinion. In the opinion here adopted the recognition of this subgenus is uncalled for. We are dealing merely with two well-marked species, and there is no particular clarification of the problems of distribution and relationship gained by further emphasis on their differences.

Genus PHTHIRUS Leach

NOTE.—The correct spelling of this name is as here given, this being the form employed by Leach. Later authors have frequently spelled it *"Phthirius,"* and Mjöberg employed the spelling *"Phtirius."*

1815. Leach, *Edinburgh Encyclopaedia*, 9: 77.
1817. Leach, *Zoölogical Miscellany*, 3: 65.
1838. Burmeister, *Genera Insectorum, Rhynchota.*
1842. Denny, *Monographia Anoplurorum Britanniae*, p. 8.
1874. Giebel, *Insecta Epizoa*, p. 23.
1880. Piaget, *Les Pediculines*, p. 628.
1904. Enderlein, *Zoologischer Anzeiger*, 28: 138.
1908. Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, pp. 5, 9.
1916. Ferris, "A Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 134, 138.
1929. Ewing, *Manual of External Parasites*, p. 147.

Anoplura with eyes; with—in the adult—distinctly five-segmented antennae which are not sexually dimorphic; with the anterior legs slender and with slender, slightly toothed claw, the middle and posterior legs very large and stout with heavy claw; thorax short and very wide, without a notal pit and without a prothoracic pleural apophysis, the sternal plate entirely lacking; paratergal plates of the abdomen perhaps to be regarded as lacking, but the fifth to eighth segments produced laterally into prominent, nipple-like, sclerotized protuberances; spiracles present on the third to eighth segments, very large and conspicuous, those of the third to fifth segments close together, with the first two displaced toward the meson; dorsum of the abdomen at the most but weakly sclerotic and without sclerotized plates in either sex; setae arranged in a single transverse row on each segment, those of the dorsum in the female being conspicuously stout and spike-like; gonopophyses of the female well developed; genitalia of the male of a distinctive type, the parameres not fused with the pseudopenis, the latter being divided into two pieces, the preputial sac small and without teeth.

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HOSTS. Occurring, as far as known, only on man and *Gorilla berengeri*.
TYPE OF THE GENUS. *Pediculus pubis* Linnaeus.

SYNONYMICAL LIST OF NAMES PREVIOUSLY USED IN THE GENUS

NOTE.—Names in italics are synonyms of the name in Roman with which they are coupled.

ferus Olafsen.
  pubis Linnaeus.
gorillae Ewing.
inguinalis Leach.
  pubis Linnaeus.
pubis Linnaeus.
  ferus Olafsen.
  inguinalis Leach.

NOTES.—Since the establishment of this genus by Leach no one has questioned its validity. Ewing has placed it in a family, Phthiriidae, by itself. While it is indeed a peculiar genus, such a separation seems to remove it unnecessarily far from its relatives, which are evidently among the other Primate-infesting forms.

As at present constituted, the genus consists of the well-known "crab louse" of man and a second species, known only from first-stage nymphs, from a gorilla.

1. Phthirus pubis (Linnaeus)

FIGS. 335, 336, 337

NOTE.—There are numerous references to this species in general texts and medical works which are not important from the point of view of this paper. Citations are given only of those which aid in tracing the nomenclatorial history or definitely add something to our knowledge of structure or biology.

1758. *Pediculus pubis* Linnaeus, *Systema Naturae*, p. 611.
1774. *Pediculus ferus* Olafsen, *Des Vise-Lavmands Eggert Olafsen's und des Landphysici Biarne Povelsen's Reise durch Island*, 1: 322. (This reference according to Fahrenholz. Apparently the pre-Linnaean name "*ferus*" was here taken up for this species.)
1815. *Phthirus inguinalis* Leach, *Edinburgh Encyclopaedia*, 9: 77.
1817. *Phthirus inguinalis* Leach, Leach, *Zoölogical Miscellany*, 3: 65.
1838. *Phthirius inguinalis* Leach, Burmeister, *Genera Insectorum, Rhynchota*.
1842. *Phthirius inguinalis* Leach, Denny, *Monographia Anoplurorum Britanniae*, p. 9; pl. 26, fig. 3.
1855. *Phthirius inguinalis* Leach, Küchenmeister, *Die in und an dem Körper des lebenden Menschen vorkommenden Parasiten*, 1: 445.
1864. *Phthirius inguinalis* Leach, Landois, *Zeitschrift für wissenschaftliche Zoologie*, 14: 1–26; pls. 1–5.
1872. *Phthirius inguinalis* Leach, Giebel, *Insecta Epizoa*, pp. 23–27; pl. 1, fig. 8.
1880. *Phthirius inguinalis* Leach, Piaget, *Les Pediculines*, pp. 628–630; pl. 51, fig. 5.
1904. *Phthirus pubis* Linnaeus, Enderlein, *Zoologischer Anzeiger*, 28: 136; figs. 10–11.
1908. *Phthirus pubis* (Linnaeus), Dalla Torre, "Anoplura," in *Wytsman's Genera Insectorum*, p. 9; fig. 2.

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1916. *Phthirus pubis* (Linnaeus), Ferris, "Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 138.
1918. *Phthirus pubis* (Linnaeus), Nuttall, *Parasitology*, **10**: 383–405; figs. 1, 3–5, 7–9.
1919. *Phthirus pubis* (Linnaeus), Nuttall, *ibid.*, **11**: 345–346.
1930. *Phthirus pubis* (Linnaeus), Nuttall, *ibid.*, **22**: 8; pl. 18.
1933. *Phthirus pubis* (Linnaeus), Ewing, *Proceedings Biological Society Washington*, **46**: 170; figs. 1*d*, 2*a*.

PREVIOUS RECORDS. Recorded from man in practically all parts of the world. Nuttall (1918) cites two records of its occurrence on dogs in Africa and Panama.

MATERIAL EXAMINED. From man in the United States; England, Nuttall, No. 206; Marquesas Islands, Pacific Entomological Survey; Australia, H. F. Clinton.

FEMALE (Fig. 335). Length about 1.5–2.00 mm. A strikingly short and broad species, with sprawling legs. Antennae (Fig. 336 *B*) relatively very large and slender and very clearly five-segmented, the apical segments apparently without sensoria. The ventral side of the head shows, near the anterior margin, two sets of peculiar structures: a pair of small, heavily sclerotic tubercles (Fig. 337 *Ct*), which have been regarded by Enderlein (1904) as the labial palpi; and, on each side (Fig. 337 *Cl*), a rather thin and delicate lobe, which has been regarded by the same author as representing the maxillary palpus. There is no reason for accepting either of these interpretations.

The eyes, in uncleared specimens, show a small but distinct pigment spot behind the lens.

The extraordinary breadth of the thorax has resulted in separating the pleural areas very widely, at least a third of the dorsal aspect of the thorax of the female—much less in the male—being membranous except for a small sclerite that articulates with the posterior border of the head. The pleurites of each side are closely fused and enclose the spiracle. No vestige of the prothoracic pleural apophysis appears. The sternum is entirely membranous.

The slender claw of the anterior leg (Fig. 337 *E*) is minutely but distinctly toothed. The tibia and tarsus of the middle and posterior legs are completely fused and bear on the inner face (Fig. 337 *G*) a series of strongly sclerotic tubercles, while the much-flattened claw of these legs (Fig. 337 *F*) likewise bears a series of tubercles on its inner face. The coxae of all legs bear a small, flattened lobe (Fig. 337 *B*).

The abdomen is much reduced, partly through a reduction in the length of all the segments, but more through the fusion of the first five, and is membranous throughout except for the usual plates of the ninth tergum, the genital plate, and the sclerotic lateral tubercles. These tubercles are

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perhaps not to be regarded as strictly homologous with the paratergal plates of *Pediculus*, since they do not enclose the spiracles. The first three pairs of spiracles are close together, the first two being displaced toward the meson, and they are all very large and conspicuous and of a peculiar, mushroom-like form (Fig. 337 *D*).

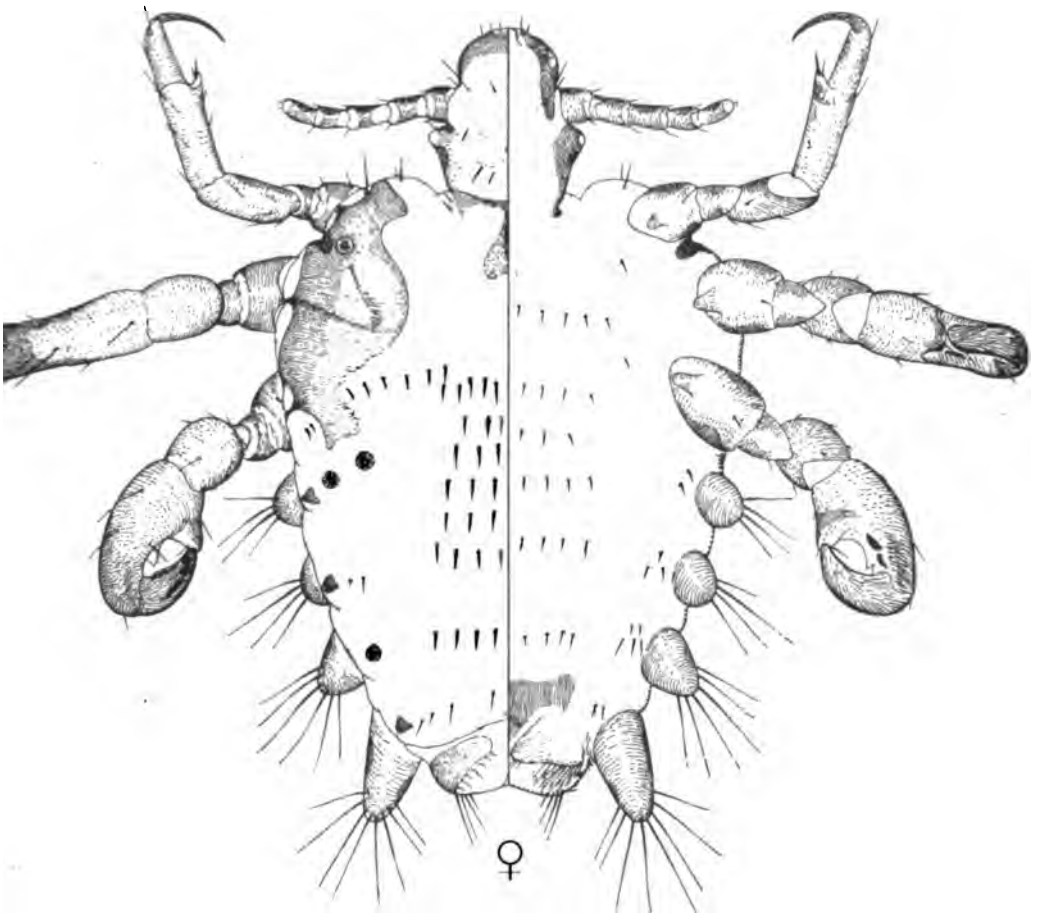

FIG. 335.—*Phthirus pubis* (Linnaeus). Female.

The gonopophyses (Fig. 337 *A*) are strongly developed and only slightly sclerotic. Opening into the uterus near the anterior margin of the genital plate is the duct of the spermatheca, this latter structure being quite large and conspicuous and of a peculiar form (Fig. 337 *A*).

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MALE (Fig. 336 *A*). Length 1.25 mm. In form of head and thorax closely resembling the female except that the thorax is not so wide. No copulatory structures are evident, and the coxae bear the same lobes as are found in the female. Abdomen much smaller than in the female, tending to be somewhat sclerotic, with the segmental lines indicated and the derm

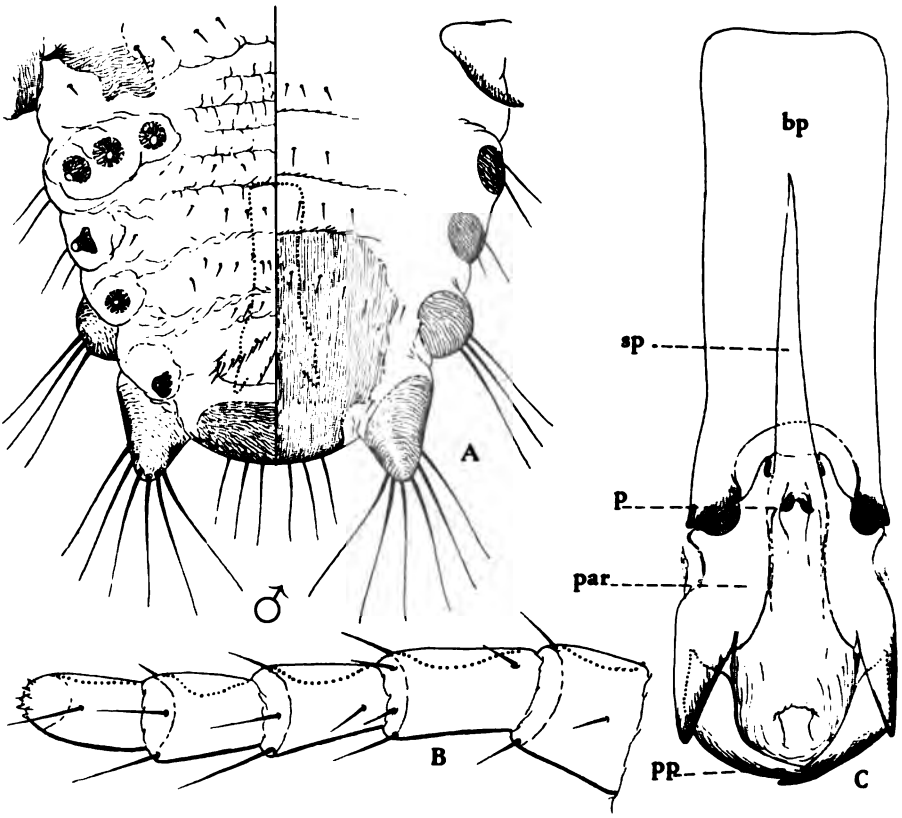

FIG. 336.—*Phthirus pubis* (Linnaeus). *A*, abdomen of male; *B*, antenna; *C*, genitalia of male.

somewhat irregularly furrowed. The marginal tubercles are smaller than in the female, and the dorsal setae are very small and inconspicuous. The anal and genital openings are somewhat removed from the apex of the abdomen, which terminates dorsally in a sclerotic plate. Ventral genital plate relatively very large. Genitalia (Fig. 336 *C*) quite small, with a long and broad basal plate (*bp*) to the apex of which articulate the short, acutely pointed parameres (*par*); articulating near the apices of the para-

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meres are two short, acute pieces which seem to be homologous with the central V-shaped piece that has herein been called the pseudopenis (*pp*);

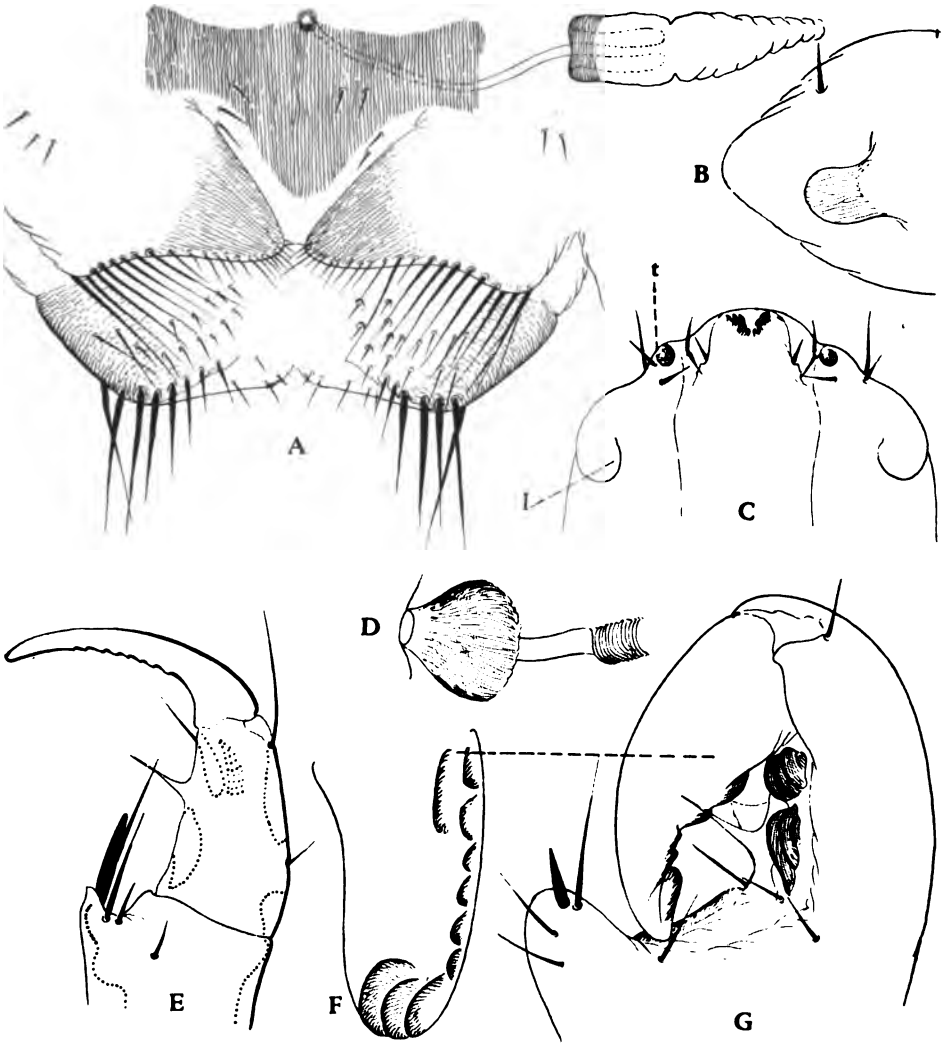

FIG. 337.—*Phthirus pubis* (Linnaeus). *A*, genital region of female, with attached seminal receptacle; *B*, portion of middle coxa, showing lobe; *C*, ventral aspect of anterior end of head, lateral tubercles (*t*) and lobes (*l*); *D*, spiracle; *E*, portion of anterior leg; *F*, inner face of middle or posterior claw; *G*, portion of middle or posterior leg.

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filling the central area is a small, wrinkled preputial sac, which bears the long statumen penis (*sp*) and the penis (*p*).

IMMATURE STAGES. These will be discussed in connection with the next species.

2. Phthirus gorillae Ewing

1927. *Phthirus gorillae* Ewing, *Proceedings Entomological Society Washington*, **29**: 120–121.

1933. *Phthirus gorillae* Ewing, Ewing, *Proceedings Biological Society Washington*, **46**: 170; figs. 1*c*, 2*b*.

PREVIOUS RECORDS. Known only from eggs and first-stage nymphs, from skins of *Gorilla berengeri* taken in the Belgian Congo.

MATERIAL EXAMINED. Not seen.

NOTES.—The original description of this species was based entirely upon the eggs and first-stage nymphs. Its author states: "The third segment of the antenna [which is the fused third to fifth] is much stouter than in *pubis;* the legs are shorter; the tarsal claws of the second and third legs are much shorter than the tarsi, have three gripping tubercles and only slight indications of terminal swellings; while these claws in *pubis* are about equal to the tarsi in length, have five gripping tubercles, in addition to terminal enlargements." In a later key, the additional information is given that in *P. gorillae* the "spine on tibial thumbs II and III [is] stout, conspicuous, and more than one-third as long as claws II and III," while in *P. pubis* it is very short and inconspicuous.

No statement is made as to the amount of material examined, nor is any indication given that a study of the possible range of variation was made. Six specimens of the first stage of *P. pubis,* taken from the same lot, have been examined in connection with the present study. Of these, five were dissected from eggs and one had hatched. It is evident from these that the number of gripping tubercles on the inner face of the claw is somewhat variable, as is the degree of their development. Furthermore, among these specimens are claws duplicating the supposedly distinctive shapes given by Ewing in his figures, as well as duplicating the different degrees of development of the tubercles, the number of which ranges from three to six. No specimens, however, show such a development of the tibial spine as is indicated for *P. gorillae.* It should be noted that considerable changes in proportions, as well as actual size, of the various parts are to be seen as between wrinkled, unhatched specimens and those which have been naturally occluded.

It would seem especially unsound, in the case of a form such as this, which is unusually interesting and important in connection with phylogenetic problems, to draw conclusions of profound significance from scanty material and without preliminary studies of the range of variation. Unfortunately, in the absence of specimens of *P. gorillae,* it is impossible to do more than express a certain skepticism as to the validity of the species.

A detailed treatment of the immature stages of *P. pubis* will be presented in a later paper.

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APPENDIX

For the sake of a more nearly complete treatment, it is desirable to append certain corrections to earlier papers, together with additional information concerning some species which have already been considered in this series. In addition, a list of species which have been described by other authors since the genera to which they belong were treated in this monograph, and which have not already been interpolated, is given. It is impracticable in the case of some of these to do more than record them. The list may be regarded as closed with January 1, 1935.

Genus **MICROTHORACIUS** Fahrenholz (Cont.)

1932. Ferris, *Contributions toward a Monograph of the Sucking Lice,* Stanford University Publications, Biological Sciences, **2**: Part V: 390.
1933. Werneck, *Memorias do Instituto Oswaldo Cruz,* **27**: 21.
1934. Werneck, *ibid.,* **29**: 179.

To Dr. Fabio Werneck is due the credit for finally clearing up the status of the species of this little genus, including the rediscovery of the long-lost *Pediculus cameli* Linnaeus, which was figured by Redi in 1668 and has not since been seen.

Attention may here be called to the apparent occurrence of eyes in the members of this genus. They are scarcely even imaginable in the weakly sclerotized material which was alone available for the basis of the discussion in an earlier part of this series, but in material now at hand they are strongly indicated (Fig. 338 *De*). There is, behind the antennae and at the point where the one-faceted eye of the Pediculidae appears, a small, lens-like protuberance. This Werneck seems to have accepted unconditionally as an eye, although stating in the case of two of the species that the eyes are without pigmentation. In uncleared specimens of *M. mazzai* there is no evidence of any ocular pigment behind the supposed lens such as occurs in the case of those species of Anoplura in which undoubted eyes exist. *In spite of the lens-like appearance, it remains to be demonstrated that these structures are actually eyes.*

One more point may be noted. The thoracic notum (Fig. 338 *Enp*) is reduced to a notal pit, which is entirely enclosed by the fused pleurites.

1. **Microthoracius cameli** (Linnaeus) (Cont.)

1932. Ferris, *Contributions toward a Monograph of the Sucking Lice,* Stanford University Publications, Biological Sciences, **2**: Part V: 394.
1934. Werneck, *Memorias do Instituto Oswaldo Cruz,* **29**: 179–183; figs. 1–5.

Werneck records the rediscovery of this species, taken from *Camelus dromedarius,* in Algeria. It is very close to *M. praelongiceps* (Neumann), differing according to Werneck as follows:

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"No parasito do camello, as duas grandes placas pigmentadas, em que se divide a placa genital da femea, são muito afastadas, deixando entre si um grande espaço, e não tocam o pequeno annel chitinisado que se encontra entre ellas. Na especie de Neumann, não só a fórma deste ultimo é inteiramente diversa como o afastamento das placas genitaes é menor e tão pequeno que estas tocam a placa mediana. O numero das cerdas que guarnecem os gonopodos e das que junto á ellas se encontram, fornece ainda elemento para distincção segura e facil entre as especies.

"Nos machos, as genitalias, embora do mesmo typo, tem caracteres proprios. Encontra-se e, *Microthoracius cameli* uma peca endomeral. entre os ramos terminaes da placa basal, fortemente recurvada, emquanto que no *Microthoracius praelongiceps* a mesma peca apresenta, apenas, ligeiro dente, como o de uma agulha de tricôt. Além disso a placa basal não tem o adelgacamento que se encontra em meio do comprimento da placa basal de *Microthoracius praelongiceps,* sendo suas margens lateraes quasi rectilineas e ligeiramente divergentes."

2. Microthoracius praelongiceps (Neumann)

FIG. 338 *A*

1909. *Haematopinus praelongiceps* Neumann, *Archives de Parasitologie,* **13**: 508–511; figs. 10–12. (In part.)

1916. *Linognathus praelongiceps* (Neumann), Ferris, "A Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), **6**: 164. (In part.)

1916. *Microthoracius praelongiceps* (Neumann), Fahrenholz, *Archiv für Naturgeschichte,* Abt. A, **81**: 11: 30. (In part.)

1932. *Microthoracius praelongiceps* (Neumann), Werneck, *Revista Medico-cirurgica do Brasil,* **40**: 346; fig.

1933. *Microthoracius praelongiceps* (Neumann), Werneck, *Memorias do Instituto Oswaldo Cruz,* **27**: 21–26; figs. 1–8.

PREVIOUS RECORDS. Recorded by Neumann from *Auchenia huanaca,* Choquecomato, Bolivia. By Werneck from *Auchenia llama,* from Argentina.

FEMALE. In the characteristics of the abdomen practically identical with *M. mazzai* Werneck (figured in Part V, Figs. 240–241, of this series as *M. praelongiceps*), but differing markedly in the form of the head and in certain characteristics of the thorax and legs. The head (Fig. 338 *A*), in comparison with that of *M. mazzai* (Fig. 338, *B* and *C*), is short and broad and the antennae are relatively large. The thoracic spiracle is quite small and inconspicuous. The legs are noticeably larger than in *M. mazzai.*

MALE. According to the figures given by Werneck, the male differs in

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the same respects as does the female and also slightly in the form of the genitalia.

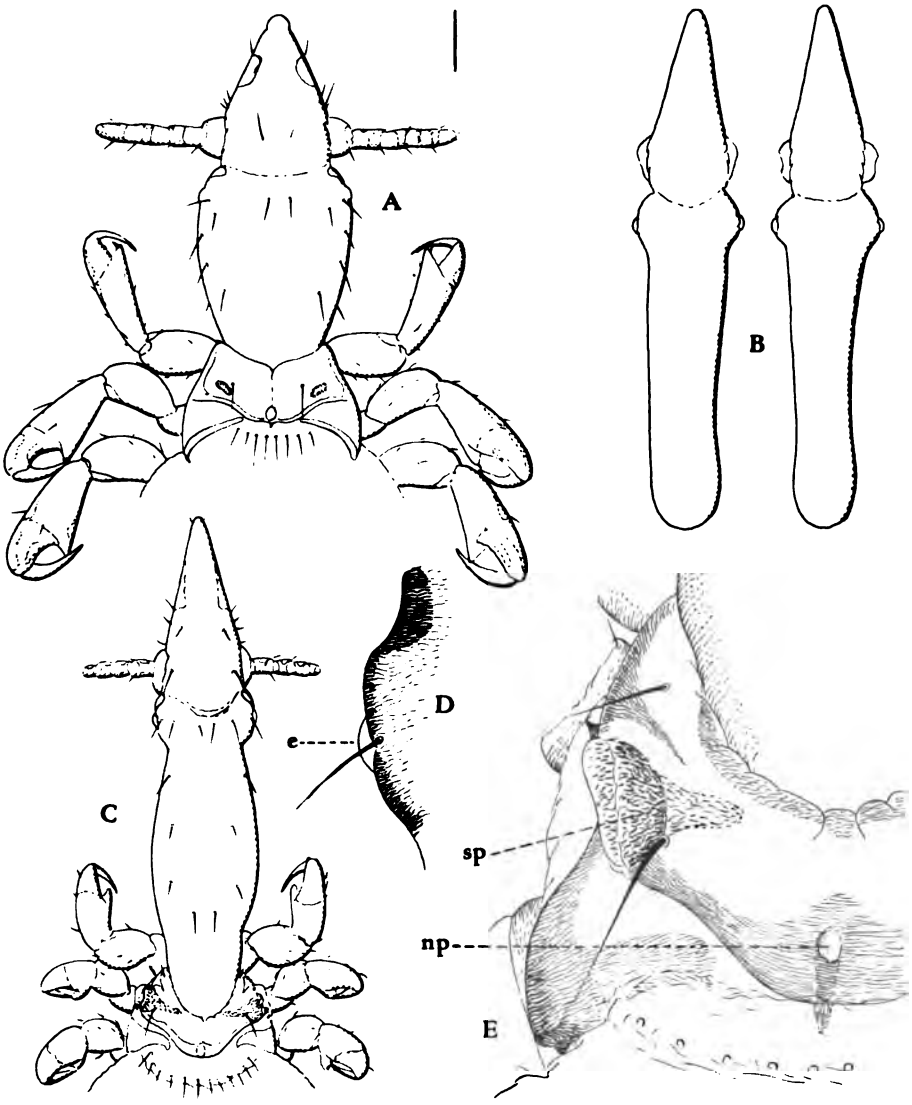

FIG. 338.—*Microthoracius praelongiceps* (Neumann). *A*, dorsal aspect of head and thorax. *Microthoracius massai* Werneck. *B*, outlines of heads; *C*, dorsal aspect of head and thorax; *D*, portion of side of head showing supposed eye (*e*); *E*, details of dorsum of thorax, spiracle (*sp*), notal pit (*np*).

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NOTES.—It is now evident that Neumann had at hand two species when he described his *Haematopinus praelongiceps*. He indicated in a footnote to his description that in one specimen, "une femelle jeune," the head was narrower than in the others. It was perhaps this particular specimen from the type lot which was at hand in connection with the previous treatment of this species in the present series and which led to the identification of the species there established.

To Werneck, who became possessed of adequate material of both species, the situation first became clear, and the quite unexpected occurrence of two species of the same genus upon the same hosts was revealed.

3. Microthoracius mazzai Werneck

FIG. 338, *B–E*

1909. *Haematopinus praelongiceps* Neumann, *Archives de Parasitologie*, 13: 509. (The specimen recorded in a footnote.)

1916. *Linognathus praelongiceps* (Neumann), Ferris, "A Catalogue and Host List of the Anoplura," *Proceedings California Academy Sciences* (4), 6: 164. In part.)

1916. *Microthoracius praelongiceps* (Neumann), Fahrenholz, *Archiv für Naturgeschichte*, Abt. A, 81: 11: 30. (In part.)

1932. *Microthoracius praelongiceps* (Neumann), Ferris, *Contributions toward a Monograph of the Sucking Lice*, Stanford University Publications, Biological Sciences, 2: Part V: 391–394; figs. 240–241. (Misidentification.)

1932. *Microthoracius mazzai* Werneck, *Revista Medico-cirurgica do Brasil*, 40: 346–348; fig.

1933. *Microthoracius mazzai* Werneck, Werneck, *Memorias do Instituto Oswaldo Cruz*, 27: 26–32; figs. 9–15.

PREVIOUS RECORDS. Recorded, as part of *M. praelongiceps* (Neumann), by Neumann from *Auchenia huanaca*, Choquecomato, Bolivia. By Werneck from *Auchenia llama*, from Argentina.

MATERIAL EXAMINED. A single immature female from the type lot of *M. praelongiceps* in the collections of the Molteno Institute, three females apparently from the type lot of *M. mazzai* received through the kindness of Dr. Werneck, and a male and four females from *Auchenia llama*, Zoölogical Garden, Washington, D.C.

NOTES.—The description and figures given in Part V of this series apply to this species and not to *M. praelongiceps*, as Werneck has pointed out. There are certain discrepancies between the material upon which this description was based and the specimens received from Dr. Werneck. In the specimens from Washington the derm is throughout very weakly sclerotic and but slightly pigmented, the specimens possibly being teneral; while in those from Argentina the head and thorax are strongly pigmented. Two specimens from Dr. Werneck's material, mounted without clearing, show the head as in Figure 338 *B*, and a cleared specimen as in Figure 338 *C*. It appears that swelling on the one hand and shrinking on the other may account for the wide discrepancy in the width of the head of the specimens previously figured in this series and those now at hand. On the other hand, it may be suspected that the exaggeratedly slender heads figured by Werneck are in some way unnatural.

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A more serious discrepancy between the two lots of specimens appears in the thoracic spiracles. In the specimens from Argentina the spiracles are relatively enormous (Fig. 338 *Esp*), while in those from Washington they are much smaller (Part V, Fig. 241 *C*). It is possible that the problem of the lice of the llamas is more involved than appears on the surface.

Genus **SCHIZOPHTHIRUS** Ferris

1932. *Hasellus,* Jancke, *Zeitschrift für Parasitenkunde,* 4: 532.

Jancke, unaware of the genus *Schizophthirus,* which was established in Part III of this series (1922) with *Pediculus pleurophaeus* Burmeister as its type, has utilized this species as the type of his genus *Hasellus.* The latter will fall as a clear synonym.

Schizophthirus pleurophaeus (Burmeister)

1932. *Hasellus pleurophaeus* (Burmeister), Jancke, *Zeitschrift für Parasitenkunde,* 4: 532–535; fig. 4.

Jancke, who has had the privilege of examining the Giebel Collection, which is still extant, has redescribed this species from material in this collection. It is evident from his description and figures, in spite of certain discrepancies due to the condition of the material, that the identification of the species established in the earlier part of this series is correct.

Genus **POLYPLAX** Enderlein

Polyplax spinulosa (Burmeister)

Specimens in the collection of the Molteno Institute of Cambridge University, bearing the label, "*Polyplax spiniger* (Denny), off *Mus decumanus,* Cambridge, 1908, G. H. F. Nuttall coll., G. Neumann det.," are *P. spinulosa.*

Two slides in the Piaget Collection, labeled "*Haematopinus spiniger,* sur un *Hypudeus amphibius,*" are likewise *spinulosa.* It was probably upon these specimens that Piaget's description and figure were based.

Polyplax serrata (Burmeister)

1932. *Polyplax serrata* (Burmeister), Jancke, *Zeitschrift für Parasitenkunde,* 4: 252; fig.

Jancke records finding in the Giebel Collection a single female of *serrata.* He concludes that *P. affinis* (Burmeister), as understood by Fahrenholz, is a synonym of this. It should be noted that Fahrenholz's identification of *affinis* is not herein accepted, this name being used for a species of *Hoplopleura.*

Several slides in the collection of the Molteno Institute, labeled "*Poly-*

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plax spinulosa (Burm.), off house mouse, Dr. W. W. C. Tapley, London, 1921," are this species. Jancke records it from "Waldmaus," Germany.

Polyplax reclinata (Burmeister)

1932. *Polyplax reclinata* (Burmeister), Jancke, *Zeitschrift für Parasitenkunde*, 4: 525–527; fig. 2*a*.

Jancke reports this species from *Sorex araneus*, Germany, and gives notes upon it.

Polyplax reclinata leucodontis Jancke

1932. *Polyplax reclinata leucodontis* Jancke, *Zeitschrift für Parasitenkunde*, 4: 526; fig. 2*b*.

Proposed for specimens from *Sorex leucodon*, Germany.

Polyplax alaskensis Ewing

1927. *Polyplax alaskensis* Ewing, *Proceedings Entomological Society Washington*, 29: 118–119.

Based upon a single male from *Microtus* sp., Alaska.

Polyplax borealis Ferris

1933. *Polyplax borealis* Ferris, *Parasitology*, 25: 127–129; fig.

From *Evotomys* sp. (*rufocanus*?), Beskenjarrga, Finmark, Norway.

Polyplax praomydis Bedford

1929. *Polyplax praomydis* Bedford, *Director of Veterinary Services, Union of South Africa, Annual Report*, 15: 503–504; figs. 2–5.

From *Praomys namaquensis monticularis* (family Muridae), Onderstepoort, South Africa.

Genus HOPLOPLEURA Enderlein

Hoplopleura oenomydis Ferris

1924. *Hoplopleura pacifica* Ewing, *Bishop Museum Bulletin*, 14: 9–11; fig. 1, *b* and *c*.
1932. *Hoplopleura oenomydis* Ferris, Ferris, *ibid.*, 98: 121–127; figs. 37–39.

Hoplopleura pacifica Ewing, described from *Rattus hawaiiensis*, Hawaii, is considered by the writer to be a synonym of *H. oenomydis* Ferris. The species was recorded by Ferris (ref. cited) from rats in the Marquesas Islands. Specimens from rats in the Hawaiian Islands have recently come

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to hand and confirm this conclusion. The species appears to be widely distributed throughout the region from Africa to the South Sea Islands.

Hoplopleura reducta Ferris

Two specimens, male and female, in the British Museum labeled merely "South America" are of this species, which has previously been known from a single record and the female only. Unfortunately the male is not in condition to be figured.

Hoplopleura brasiliensis Werneck

1931. *Hoplopleura brasiliensis* Werneck, *Comptes rendus des séances de la société de biologie de Rio de Janeiro,* 109: 754; fig.

1932. *Hoplopleura brasiliensis* Werneck, *Memorias do Instituto Oswaldo Cruz,* 26: 235–237; pls. 45–46.

From undetermined host in the State of Goyaz, Brazil.

Hoplopleura travassosi Werneck

1932. *Hoplopleura travassosi* Werneck, *Revista Medico-cirurgica do Brasil,* 40: 345–346; fig.

1933. *Hoplopleura travassosi* Werneck, Werneck, *Memorias do Instituto Oswaldo Cruz,* 27: 409; figs. 1–6.

From *Oryzomys flavescens,* Angra dos Reis, state of Goyaz, Brazil. Also from *Kannabateomys amblionyx* and *Oxymycterus judex,* Humboldt, state of Santa Catharina, Brazil.

Hoplopleura fonsecai Werneck

1933. *Hoplopleura fonsecai* Werneck, *Memorias do Instituto Oswaldo Cruz,* 27: 412–415; figs. 7–11.

From undetermined host, Humboldt, state of Santa Catharina, Brazil.

Genus NEOHAEMATOPINUS Mjöberg

Neohaematopinus laeviusculus (Grube)

Specimens in the British Museum from *"Citellus* sp., Odessa, South Russia, 1927," and others from *"Citellus erythrogenys,* Omsk, Siberia," agree quite closely with examples from America.

Neohaematopinus sciuri Jancke

1932. *Neohaematopinus sciuri* Jancke, *Zeitschrift für Parasitenkunde,* 4: 241–246; figs. 1–11.

From *Sciurus vulgaris,* Naumburg, Germany.

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Genus **HAEMODIPSUS** Enderlein

Haemodipsus africanus Bedford

1934. *Haemodipsus africanus* Bedford, *Onderstepoort Journal Veterinary Science and Animal Industry*, 2: 48; fig. 10.

From *Lepus zuluensis*, Jericho, Transvaal, South Africa.

Genus **EULINOGNATHUS** Cummings

Eulinognathus caviae Werneck

1934. *Eulinognathus caviae* Werneck, *Memorias do Instituto Oswaldo Cruz*, 29: 183-187; figs. 6–11.

From *Galea leucoblephara*, Jujuy, Argentina.

Genus **SOLENOPOTES** Enderlein

Solenopotes burmeisteri (Fahrenholz)

1932. *Cervophthirius crassicornis* (Nitzsch), Jancke, *Zeitschrift für Parasitenkunde*, 4: 527–531; fig. 3.

Jancke here redescribes this species from material in the Giebel Collection. He was apparently unaware of the fact that Fahrenholz had previously renamed the species owing to the preoccupation of the name.

Solenopotes ferrisi (Fahrenholz)

1932. *Cervophthirius ferrisi* Fahrenholz, Jancke, *Zeitschrift für Parasitenkunde*, 4: 529.

Jancke, on the basis of his examination of Giebel's material of *Solenopotes burmeisteri* (*crassicornis*), recognized that the record by Ferris of this species from *Odocoileus* in California was based upon a misidentification. He therefore renamed the California species *ferrisi*, unaware of the fact that the same name had been employed by Fahrenholz (1919) for the same species.

Genus **LINOGNATHUS** Enderlein

Linognathus lewisi Bedford

1934. *Linognathus lewisi* Bedford, *Onderstepoort Journal Veterinary Science and Animal Industry*, 2: 48; fig. 11.

From *Gazella thomsoni*, Naivasha, Kenya Colony, Africa.

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Genus **HAEMATOPINUS** Leach

Haematopinus elegans Fahrenholz

It was stated in the earlier discussion of *Haematopinus asini* (Linnaeus) (Part VI, p. 467) that specimens of *H. elegans* Fahrenholz were not available. This was an unfortunate error. Specimens labeled "Type" of *H. elegans* were received through the kindness of the Berlin Museum, and an overlooked note concerning them states: "They confirm the belief that this species is a synonym of *H. asini.*"

Haematopinus bufali (de Geer)

It was stated in the earlier treatment of this species (Part VI, p. 463) that positive identification of its host was lacking. Since that time specimens have been received through the kindness of Mr. G. D. E. Hopkins, of Uganda, of which the host was positively identified as *Syncerus* (= *Buffelus*) *caffer radcliffei,* from the shores of Lake Edward, Uganda.

NAMES GENERICALLY UNPLACED

The following names cannot be referred here definitely to a genus, because of either inadequacy of the description or unavailability of the publication in which they were established.

Pediculus aquaticus Pontoppidan, *Danske Atlas,* 1:699 (1763). Reference according to Sherborn. The reference is unavailable, and the name has never been taken up by entomologists.

Pediculus ferus, Pediculus collaris, and *Pediculus papillosus* Von Olfers, *De vegetativis et animatis corporibus in corporibus animatis reperiundis commentarius,* 1:80–85 (1816). These names are as given by Fahrenholz, who is apparently the only student of the Anoplura ever to have seen this rare and troublesome dissertation. It is probable that the name *"ferus"* applies to *Phthirus pubis,* it being a pre-Linnaean name for this species. Fahrenholz makes no statement concerning the other names.

Pediculus spiculifer Gervais, in Walckenaer's *Histoire naturelle des insectes aptères,* 3:302 (1844). This is apparently a species of *Hoplopleura* or *Polyplax.* From *"Mus barbarus,"* now known as *Lemniscomys barbarus,* Algiers. The name may eventually be cleared up by adequate collections from this host.

Pediculus clavicornis, Nitzsch, *Zeitschrift für die gesamten Naturwissenschaften,* 23:32 (1864). *Haematopinus clavicornis* (Nitzsch), Giebel, *Insecta Epizoa,* p. 37 (1874). An unrecognizable species, probably of *Hoplopleura,* if we may judge by Giebel's redescription which was based upon a single female from *Meriones* sp. from Africa.

CONCLUSION

The series of papers entitled *Contributions toward a Monograph of the Sucking Lice* is herewith brought to a close. It falls somewhat short of

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the goal that was originally set, although in some respects it has more nearly attained completeness than was anticipated. The original plan of the work involved the presentation, first, of the purely descriptive material, which would make possible the identification of genera and species; this to be followed by a consideration of morphology, a development of the general classification as a synthesis of the preceding work, a résumé of what is known concerning the biology of the group, an analysis of the problems of distribution, keys to genera and species, a host list, and other general material. But the volume has already grown to such proportions that it must be closed before this aim has been achieved. It is hoped, however, that this additional material may eventually be presented in a separate volume.

But as far as the descriptive material is concerned, it may perhaps justifiably be felt that the original aim has been entirely achieved. In fact, it has been possible to deal with a larger proportion of the species of the order than could have been hoped for when the work was begun. Through the co-operation of numerous individuals and institutions it has been possible to see almost all of the described species. In the case of a gratifyingly large number, types or other authentic material have been available, and there are but few species that remain obscure or doubtful. It may be noted that out of the slightly more than two hundred species recognized in this work ninety or more have been first described by the present writer in its pages or in earlier papers.

In view of the fact that this monograph will probably stand for some time as the principal work of reference for the Anoplura, it may not be out of place to present a brief historical review that will reveal the origins of the material upon which it is based and make possible a proper acknowledgment of the aid that has been received.

In the summer of 1913 the writer, then a student at Stanford University, was sent by Professor Vernon L. Kellogg, then head of the Department of Entomology of this institution, to accompany a field party from the Museum of Vertebrate Zoölogy of the University of California which was engaged in collecting birds and mammals along the northwest coast of California under the direction of Dr. Joseph Grinnell. From this expedition a considerable amount of parasite material was obtained. Again, in 1915, he was sent with another party from the same institution which was engaged in a biological survey of Yosemite National Park. At the close of this expedition the writer arranged with Dr. Grinnell for permission to examine skins in the Museum of Vertebrate Zoölogy, and from these still more material was obtained.

So successful was this examination of skins in producing material which could not otherwise have been secured that it was proposed to extend it further. Through Dr. Kellogg arrangements were made with Dr. L. O.

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Howard, then Honorary Curator of Insects at the United States National Museum, to secure permission to examine the mammal skins in the collections of that institution. In the summer of 1916 the writer spent more than two months of concentrated work going over these skins, and from them took an enormous collection of ectoparasitic material. It is understood that specimens of all species collected will be deposited in the collections of the United States National Museum, except where to do so will cause an undue impairment of the value of the material through its division. In these cases specimens of other species may be substituted. The holotypes of all species remain in the Stanford University collections, and paratypes are in the collections of the National Museum. A few days were spent in examining the skins at the Field Columbian Museum in Chicago, practically nothing being secured that had not also been found in Washington.

It may be noted here that this method of collecting is especially fruitful in connection with the parasites of the smaller mammals. The study skins of these forms are so handled in their preparation that the dead parasites may easily remain clinging to the hairs. Because of this it might well be possible to obtain a practically complete representation of the mallophagan and anopluran fauna of the rodents, the insectivores, and the smaller carnivores from skins already present in museums. In the case of the larger mammals, the skins are usually tanned and thoroughly cleaned, with the complete loss of the parasite fauna. The obtaining of parasites from these mammals therefore depends upon the accident of interest on the part of those by whom the animals are killed or on the possibility of examining animals in zoölogical gardens.

With the material thus obtained as a basis, this monograph was begun. Extensive as the material was, there were still many gaps, especially in the genera from the larger mammals. As has been noted in the preface to Part V of this series, it became possible for the writer to spend part of his sabbatical leave of 1930–31 at the Molteno Institute for Research in Parasitology, at Cambridge University. Through the assistance of Professor G. H. F. Nuttall, then Quick Professor of Zoölogy of Cambridge University and Director of the Molteno Institute, not only were the collections of the Institute—especially important in the case of the genus *Pediculus*—made available, but the support of other institutions was secured. To these institutions—the Hamburg Museum, the Berlin Museum, and the British Museum—acknowledgments have already been made, but they may well be renewed. And, once more, special acknowledgments may be made to Mr. Lawrence Hill and Mr. G. A. H. Bedford of South Africa, to Mr. L. H. Dunn of Panama, and to Dr. Fabio Werneck of Brazil, who have unselfishly made available material that has contributed much to the value of this work. And there have been others, both institutions and individuals,

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whose smaller contributions have aided to fill the gaps and to whom acknowledgments have been made in the proper places.

The result of this co-operation is that probably nearly half of the existing species of sucking lice are now described in something approaching a satisfactory fashion as far as the mere recognition of genera and species on the basis of preserved material is concerned.

And, finally, since this monograph has throughout proceeded in a manner essentially the direct reverse of that which would ordinarily be followed in a treatise of this kind, it may very well end with that which usually comes first—a dedication.

To

PROFESSOR G. H. F. NUTTALL

Of Cambridge University

As an expression of personal affection and professional respect

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